Journal
of
The Franklin Institute

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AWARDS BY THE INSTITUTE

The Franklin Medal (1914—Gold Medal).—This medal is awarded annually from the Franklin Medal Fund, founded January 1, 1914, by Samuel Insull, Esq., to those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, acting through its Committee on Science and the Arts, have done most to advance a knowledge of physical science or its applications.

The Elliott Cresson Medal (1848—Gold Medal).—This medal is awarded for discovery or original research, adding to the sum of human knowledge, irrespective of commercial value; leading and practical utilizations of discovery; and invention, methods or products embodying substantial elements of leadership in their respective classes, or unusual skill or perfection in workmanship.

The Howard N. Potts Medal (1906—Gold Medal).—This medal is awarded for distinguished work in science or the arts; important development of previous basic discoveries; inventions or products of superior excellence or utilizing important principles.

The John Price Wetherill Medal (1925—Silver Medal).—This medal is awarded for discovery or invention in the physical sciences or for new and important combinations of principles or methods already known.

The Edward Longstreth Medal (1890—Silver Medal).—This medal is awarded for inventions of high order and for particularly meritorious improvements and developments in machines and mechanical processes. In the event of an accumulation of the fund for medals beyond the sum of one hundred dollars, it is competent for the Committee on Science and the Arts to offer from such surplus a money premium for some special work on any mechanical or scientific subject that is considered of sufficient importance.

The Louis E. Levy Medal (1923—Gold Medal).—This medal is awarded to the author of a paper of especial merit, published in the JOURNAL OF THE FRANKLIN INSTITUTE, preference being given to one describing the author's experimental and theoretical researches in a subject of fundamental importance.

The George R. Henderson Medal (1924—Gold Medal).—This medal is awarded for meritorious inventions or discoveries in the field of Railway Engineering.

The Walton Clark Medal (1926—Gold Medal).—This medal is awarded to the "author of the most notable advance in knowledge or improvement in apparatus, or in method concerning the science or the art of gas manufacture or distribution or utilization in the production of illumination, or of heat, or of power."

The Frank P. Brown Medal (1938—Silver Medal).—This medal is awarded to inventors for discoveries and inventions involving meritorious improvements in the building and allied industries.

The Newcomen Medal (1943—Gold Medal).—This medal is awarded, not oftener than once in three years, for achievement in the field of Steam.

The Francis J. Clamer Medal (1943—Silver Medal).—This medal is awarded at least once in five years for meritorious achievement in the field of Metallurgy.

The Stuart Ballantine Medal (1946—Gold Medal).—This medal is to be awarded in recognition of outstanding achievement in the fields of Communication and Reconnaissance which employ electromagnetic radiation.

The William M. Vermilye Medal (1937—Bronze Medal).—This medal is awarded biennially in recognition of outstanding contribution in the field of Industrial Management.

The Certificate of Merit (1882).—A Certificate of Merit is awarded to persons adjudged worthy thereof for meritorious inventions, discoveries or improvements in physical processes or devices.

The Boyden Premium.—Uriah A. Boyden, Esq., of Boston, Mass., has deposited with The Franklin Institute the sum of one thousand dollars, to be awarded as premium to "any resident of North America who shall determine by experiment whether all rays of light and other physical rays are or are not transmitted with the same velocity."

For further information relating to these awards apply to The Executive Director.

(Revised to April, 1948.)

THE BUILDING ERECTED BY THE FRANKLIN INSTITUTE IN 1933.

The Cornerstone was laid in the fall of 1932. John T. Windrim was the Architect.

Journal
of
The Franklin Institute
Devoted to Science and the Mechanic Arts

Vol. 247 APRIL, 1949 No. 4

INTRODUCTION.

BY

HENRY B. ALLEN.

Executive Vice-President and Secretary.

In celebrating the 125th anniversary of the founding of The Franklin Institute, we are not, with vanity, glorying in our antiquity. Rather, with humility, we are re-studying (truly *re*-viewing) the past in order to gain a better understanding of the present and to chart more wisely the future.

The pages of the old minute books are musty and stained; upon them is the moisture of more than twelve decades; the ink is faded; but the spirit of the writing is as fresh and as virile today as it was in 1824.

Our members and friends will enjoy re-reading as much as we do these old pages of our first four quarterly reports, those inspiring words of our founders. And I am sure that the implication of the words, and their application to today's problems of today's Franklin Institute, will be as obvious to each of you as they have so often been to me.

History would be useless if it merely tickled man's vanity, but history is our inspiration when we can see in the records of men who came before us lessons that we can apply to today's problems. From the early record books of the Institute I have found many lessons that have helped me in meeting today's problems.

One of the things about The Franklin Institute that has always fascinated me is the uncanny precision of the founders' plans, and the unerring way those plans have been followed, not slavishly, not followed merely to carry out the letter of the plan, but followed wisely, and in spite of changing conditions, because the plans themselves were right.

The first section of the Constitution of the Institute, adopted February 5, 1824, after stating that the name of the new society is to be the "Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts," explains its purpose: "The object of this Institute shall be the promotion and encouragement of Manufactures and the Mechanic and Useful Arts, by the establishment of Popular

(Note—The Franklin Institute is not responsible for the statements and opinions advanced by contributors in the JOURNAL.)

Lectures on the Sciences connected with them; by the formation of a Cabinet of Models and Minerals, and a Library; by offering Premiums on all objects deemed worthy of encouragement; by examining all new Inventions submitted to them, and by such other means as they may judge expedient."

How wisely did our founders express the purposes of the Institute. And how closely do we still follow that pattern today; our lectures (both highly technical and less so) are still one of the most important features of the entire program. Our "cabinet of models and minerals" has grown into one of the country's greatest museums of science and industry. Our library has grown from a handful of volumes to one of the most useful collections of its kind in the world. Our "premiums" were originally given to American makers of such homely products as cotton yarns, woolen goods, leather goods, earthenware, glass, cabinet ware, straw bonnets, musical instruments, steel, agricultural implements, and paints, in the hope that these American-made products might compete with similar European-made goods. Today our medals are the internationally famed recognition to those great pioneers working in fundamental sciences and engineering—Rutherford, the Curies, Edison, Einstein, Marconi, Shapley, Whitney, Fermi, Wright among others; as well as those making improvements in equipment and product.

Another of our very early activities that is just as important today as it was in the first days of the Institute is this JOURNAL. In the first quarterly report we find this reference: "A measure of . . . importance would be the publication of a Journal, on the plan of that recently commenced in London, and of which it is said that one hundred thousand copies are sold in London and its immediate vicinity. No doubt can exist that such a Journal would diffuse among our mechanics, at a low rate, much useful information; that it would contribute to make known, without delay, the improvements of our artists, and by securing to them the merit of their discoveries, would afford them both wealth and reputation. But it cannot be doubted, that the establishment of such a Journal at this time would be premature, and that it might involve the Society in difficulties, which it is peculiarly desirable to avoid at the origin of our Institution."

On August 1, 1825, however, a prospectus was issued, announcing the fact that "shortly will be published THE FRANKLIN JOURNAL AND MECHANICS MAGAZINE." The object of this Journal, as defined in the prospectus, was "to diffuse information on every subject connected with the useful arts." Many of the early articles were translations or abstracts of significant articles published in Europe, but the new JOURNAL soon gained a character of its own, and the publication of original work became its principal feature.

If I may be permitted one more reference to that first quarterly

report, and one more quotation, let me call your attention to this statement: "There are objects of still greater importance, which the Board entertain a hope may at some future day be within the means of the Society; foremost among these would be the establishment of an Experimental Workshop and Laboratory, for the better instruction of Members by the results of experience; but this would require a much larger sum of money than the Society has at present at its disposal. All that your Board will therefore venture to suggest on this subject is, that the Society should not lose sight of it, but embrace the first opportunity of stamping upon their Institution the greatest degree of usefulness, by the creation of such an experimental school."

Actually, of course, this idea developed into two major activities: first, a school, that existed for ninety-nine years, and served as the model for Philadelphia's public high schools; and, second, research—our Bartol Research Foundation, and our Laboratories for Research and Development; activities that today engage the talents and labors of more scientists, technicians, and engineers, than all other Franklin Institute activities combined. We sometimes think of our latter "Laboratories for Research and Development" as a new activity, because all our industrial research work was combined into a single administrative unit early in the last war, and greatly expanded. That is why I like to point out this early quotation from our first quarterly report, showing that the founders of the Institute were also greatly interested in establishing an "Experimental Workshop." Also, to give you some idea of the importance of Franklin Institute research work during the first fifty years of our existence, let me call your attention to these dates:

1827—our scientists investigated the costs, construction, and operation of dry docks.

1829—we studied the use of water as a source of industrial power.

1830—aided by the first Federal research grant ever made, we studied steam boiler explosions, then occurring with alarming frequency, and recommended improved construction, and safety measures.

1833—at the request of the Pennsylvania Legislature, our scientists made a study of standard weights and measures of France, England and the United States, as well as the Troy pound used in the U. S. Mint; and on our recommendations the present laws of the State of Pennsylvania concerning standardization of weights and measures were based.

1843—for the City of Philadelphia, we made a detailed study of the best methods of paving highways.

1868—our engineers developed the standardization of thread patterns for nuts and bolts, which was adopted by the United States government, and which has remained standard until today. (This is of particular interest now in view of the recent adoption of a joint standard for American and British thread patterns.)

1875—for the City of Philadelphia our research men studied the city's pumping stations and reservoirs, and recommended possible sources for a future supply of fresh water.

1884—during and following the Institute's International Electrical Exhibition in Philadelphia, there were conducted the most complete tests of electrical equipment up to that time.

The above list is far from complete, but it does give a rough idea of the scope and the diversity of early Franklin Institute research activities. In more recent times our energies have been concentrated, of course, on projects for the Armed Forces and for private industries, as well as for the increase of knowledge. Today our well-equipped and well-staffed laboratories for industrial research and development and for new knowledge are making a signal contribution to the "promotion of the mechanic arts."

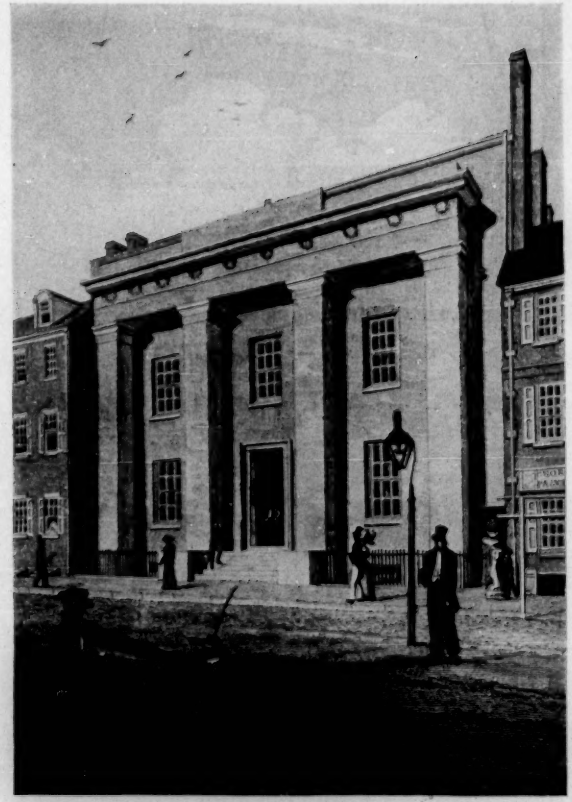
In celebrating 1949 as the 125th anniversary of the founding of The Franklin Institute, we are also celebrating another anniversary—the 200th anniversary of Franklin's electrical experiments, and it seems to me peculiarly appropriate that these two anniversaries fall in the same year, for the entire program of The Franklin Institute serves to honor that great scientist-statesman.

In closing, I can do no better than to recommend to you those prophetic words he wrote to a fellow scientist, Joseph Priestley, in 1780:

". . . The rapid progress true science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the height to which may be carried, in a thousand years, the power of man over matter. We may perhaps learn to deprive large masses of their gravity, and give them absolute levity, for the sake of easy transport. Agriculture may diminish its labour and double its produce; all diseases may by sure means be prevented or cured, not excepting even that of old age, and our lives lengthened at pleasure even beyond the antediluvian standard. O that moral science were in a fair way of improvement, that men would cease to be wolves to one another, and that human beings would at length learn what they now improperly call humanity."

In the first quarterly report made to the Institute on April 15, 1824 the Board of Managers said: "Your Board have been anxious to commence immediately the usefulness of the Institute . . . but as the funds of the Society are still very low . . ." and again ". . . but they flatter themselves that by the liberality of the members in particular, and of the public at large, the expense . . ." etc.

We can only add today that our field of usefulness has been expanded, and costs have increased. As Franklin had Poor Richard humorously say "an empty bag cannot stand upright," so today we appeal to the generosity of members and of the public at large to enable The Franklin Institute to continue its usefulness to mankind for another one hundred and twenty-five years.



THE BUILDING ERECTED BY THE FRANKLIN INSTITUTE IN 1825.
The Cornerstone was laid June 8, 1825. John Haviland was the Architect.

FIRST ANNUAL REPORT

OF THE

PROCEEDINGS

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

FOR THE PROMOTION OF THE MECHANIC ARTS.

TO WHICH ARE PREFIXED THE

CHARTER, CONSTITUTION, AND BY-LAWS

OF THE

INSTITUTE,

WITH

A list of the Members, and Officers for 1824 *and* 1825.

AND OF THE

STANDING COMMITTEES FOR 1825

PHILADELPHIA

PUBLISHED BY ORDER OF THE INSTITUTE.

J. HARDING, PRINTER

1825

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1825

At the first annual meeting of the "Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts," held at the Hall of the Institute, on Thursday, January 20, 1825, the Board of Managers offered their fourth quarterly report, including an abstract of their proceedings during the first year of the Institute.

Whereupon, on motion, it was

Resolved, That the Report be accepted.

Resolved, That the Board of Managers be authorized to publish the report in a pamphlet form, with such documents as they shall deem expedient.

Resolv d, That the thanks of the Institute be presented to the Board of Managers, for the assiduous care and attention manifested by them in the administration of its affairs during the past year.

JAMES RONALDSON, *President*

WM. STRICKLAND, *Secretary*.

Officers of the Franklin Institute for 1825.

President.

James Ronaldson.

Vice Presidents.

Mathew Carey, Isaiah Lukens.

Recording Secretary.

William Strickland.

Corresponding Secretary.

Peter A. Browne.

Treasurer.

Thomas Fletcher.

Managers.

1. Paul Beck, Jr.
2. John Harrison.
3. Samuel R. Wood.
4. William H. Keating.
5. Daniel Groves.
6. John Haviland.
7. Samuel V. Merrick.
8. William Abbott.
9. John D. Eisenhut.
10. John P. Wetherill.
11. James Clarke.
12. Abraham Miller.
13. James Harper.
14. Adam Ramage.
15. Harvey Lewis.
16. Robert M. Patterson.
17. James M'Alpin.
18. William Fry.
19. William Kneass.
20. Joseph Donaldson.
21. William Rush.
22. Isaac B. Garrigues.
23. William S. Warder.
24. Lloyd Mifflin.

Standing Committees for 1825.

I. OF FINANCE.

Paul Beck, jr.

James M'Alpin. — James Harper.
Samuel V. Merrick. — William Fry.

II. ON LECTURES.

Peter A. Browne.

Samuel R. Wood. — Joseph Donaldson.
John D. Eisenhut. — Isaac B. Garrigues.

III. ON THE LIBRARY.

Abraham Miller

William Rush. — William Abbott.
Harvey Lewis. — William S. Warder.

IV. ON MODELS.

William Strickland.

Robert M. Patterson. — James Clark.
John Haviland. — Isaiah Lukens.

V. ON MINERALS.

William H. Keating.

Isaiah Lukens. — John P. Wetherill
Peter A. Browne. — Abraham Miller

VI. ON PREMIUMS AND EXHIBITIONS.

James Ronaldson.

Adam Ramage. — Samuel V. Merrick
William H. Keating — William Knowles

VII. ON THE ROOMS.

Harvey Lewis. William S. Warder.

VIII. ON PUBLICATIONS.

Peter A. Browne.

William H. Keating. Mathew Carey.

OFFICERS OF THE BOARD FOR 1825.

Chairman.

Mathew Carey.

Secretary.

Samuel V. Merrick.

Curators.

Samuel V. Merrick. William S. Warder

AN ACT

To incorporate the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same*, That the subscribers to the association called the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, and all such persons as may hereafter be admitted members of the same, shall be, and they are hereby declared to be, a body politic and corporate, by the name and style of "The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts," to have perpetual succession, to sue and be sued, implead and be impleaded, in all courts of record or elsewhere, to use a common seal, and break, alter, and renew the same at pleasure, and to take, hold, and enjoy lands, tenements, and hereditaments; *Provided* that the yearly income of the real estates held by them shall not exceed two thousand dollars.

SECTION 2. *And be it further enacted by the authority aforesaid*, That the objects of the said orporation shall be the promotion and encouragement of manufactures and the mechanic and useful arts, by the establishment of popular lectures on the sciences connected with them, by the formation of a cabinet of models and minerals, and a library, by offering premiums on all objects deemed worthy of encouragement, by examining all new inventions submitted to them, and by such other measures as they may judge expedient.

SECTION 3. *And be it further enacted by the authority aforesaid,* That the members of the said corporation shall consist of manufacturers, mechanics, artizans, and persons friendly to the mechanic arts; they shall pay such sum annually or in gross as shall be required by the by-laws of the said corporation for an annual or life subscription; *Provided* that nothing herein contained shall be construed to prevent the said corporation from electing honorary or corresponding members, who may be exempted from such payments and other duties of membership, in such manner and to such extent as may be prescribed by the by-laws of the said corporation.

SECTION 4. *And be it further enacted by the authority aforesaid,* That the officers of the said corporation shall be a president, two vice-presidents, a recording secretary, a corresponding secretary, a treasurer and twenty-four managers, who shall together constitute a board of managers of the said corporation, and such other officers as the said corporation shall deem needful; two-thirds of the managers shall be manufacturers or mechanics; the said officers shall be elected at an annual meeting of the said corporation, to be held on the third Thursday of January; if an election shall not take place on that day, the corporation shall not for that cause be dissolved, but an election shall be held as soon afterwards as may be, and until such election the officers in place shall continue to act; public notice of all elections shall be given in such manner as may be prescribed by the by-laws of the said corporation; the present officers of the said association are hereby constituted the officers of the corporation hereby created; and shall continue to hold their respective offices till otherwise elected under the provisions of this act: *Provided always,* that the said corporation shall have power to increase the number of vice-presidents and managers herein-before mentioned, to such number as may be deemed advisable and convenient at a stated meeting of the said corporation, the same public notice of such intended alteration being previously given as may be required to be given of the election of officers of the said corporation.

SECTION 3. *And be it further enacted by the authority aforesaid,* That the duties and rights of the members of the said

corporation, the powers and functions of the officers thereof herein before-mentioned, and of such others as may hereafter be added, the mode of supplying vacancies in office, the times of meeting of the said corporation, and of the board of managers, the numbers which shall constitute a quorum at any such meetings, the mode of electing members, the terms of their admission, the causes which shall justify their suspension or expulsion from the corporation, and all other concerns of the said corporation shall be regulated by the by-laws and ordinances of the said corporation hereafter to be made, which the said corporation is hereby authorized and empowered to make and alter, in the manner which may be therein mentioned; *Provided* that the said by-laws or ordinances shall not be repugnant to or inconsistent with the constitution or laws of the United States or of this Commonwealth.

Office of the Clerk of the Senate of the Commonwealth of Pennsylvania, March 30th, 1824.

I certify that the foregoing Bill passed both branches of the Legislature, and received the signature of the Governor on this day. As witness my hand the day and year above written.

(Signed) JNO. DUPUY, Clerk.

CONSTITUTION.

ADOPTED FEBRUARY 5, 1824.

I. *Title and Objects.*

The Society shall be known by the name of the "FRANKLIN INSTITUTE of the State of Pennsylvania for the Promotion of the Mechanic Arts."

The object of this Institute shall be the promotion and encouragement of Manufactures and the Mechanic and Useful Arts, by the establishment of Popular Lectures on the Sciences connected with them; by the formation of a Cabinet of Models and Minerals, and a Library; by offering Premiums on all objects deemed worthy of encouragement; by examining all new Inventions submitted to them, and by such other means as they may judge expedient.

II. *Members.*

1. The Members of this Institute shall consist of Manufacturers, Mechanics, Artizans, and persons friendly to the Mechanic Arts.

2. Any person desirous of becoming a Member shall be proposed by two Members of the Society to the Board of Managers, who shall decide on his application at the next meeting. Any person who may have been rejected by the Managers may appeal to the next quarterly meeting.

3. No person shall be entitled to the privileges of Membership until he shall have paid his first annual contribution, and have signed this constitution.

4. Honorary or Corresponding Members may be elected by the Board of Managers at their discretion, and shall be reported at the next ensuing meeting of the Institute.

III. *Meetings.*

1. The Stated Quarterly Meetings of the Institute shall be held on the third Thursday in January, April, July, and October, at half past six o'clock, P. M.

2. Special Meetings shall be called by order of the President, on application of the Board of Managers, or of twelve Members. Fifteen Members shall constitute a quorum.

IV. *Payments.*

1. Every Member shall pay an annual contribution of three dollars, which will entitle him to all the benefits of the Institution.

2. The payment of twenty-five dollars shall constitute a Member for life, with an exemption from all annual payments.

V. *Officers.*

The Officers of the Institute shall be a President, two Vice-Presidents, a Recording Secretary, a Corresponding Secretary, a Treasurer, and twenty-four Managers, to be chosen annually. Two-thirds of the Managers shall be Manufacturers or Mechanics.

VI. *Elections.*

The first Election for Officers of the Institute shall be held on Monday, the 16th day of February instant, and the subsequent annual Elections shall be held on the third Thursday in January; but if no Election shall take place at that Meeting, the Officers in existence shall continue in office till a new Election be held. No Member shall be entitled to vote until all arrears shall have been paid.

VII. *President.*

It shall be the duty of the President, or, in case of his absence, of the senior Vice-President, or, in their absence, of a

President to be chosen pro tempore, to preside at the Meetings of the Institute, to preserve order therein, to put all questions, and announce the decisions.

VIII. *Secretaries.*

1. It shall be the duty of the Recording Secretary to keep a record of the proceedings of all Meetings of the Institute, and to give notice of the stated and special Meetings.

2. It shall be the duty of the Corresponding Secretary, to answer all letters addressed to the Institute, to open and maintain such correspondence as may tend to advance its interests, and to keep a record of such correspondence, subject to the directions of the Board of Managers; he shall notify to all honorary or corresponding Members their Election.

IX. *Treasurer.*

It shall be the duty of the Treasurer to collect and receive all monies of the Institute. He shall make no payments without written vouchers from the Board of Managers. He shall keep accurate accounts of the Income and Disbursements of the Institute; exhibit an accurate statement of his receipts and payments at the Quarterly Meetings of the Institute, and whenever called upon by the Board of Managers, and give bond for the faithful performance of his trust.

X. *Managers.*

1. All the Officers of the Society shall be Members of this Board, and to the said Board shall be confided, in general, the various objects and concerns of the Institute, with authority to devise and execute all measures which may advance its interests.

2. They shall keep regular Minutes of their proceedings, and submit them to the Institute when called upon.

3. They shall, at the quarterly Meetings of the Institute, present a detailed report of their proceedings.

4. They shall hold stated meetings once in each month. They shall elect their officers, and be at liberty to make by-laws for

their own regulation, and that of the Institute. Seven of their number shall constitute a quorum.

5. They shall have power to fill vacancies in their Board from Members of the Institute.

XI.

To alter or amend this Constitution, notice shall be given, stating the intended Amendment, at any Meeting of the Institute, and it shall be acted upon at the next or any subsequent Meeting. If two-thirds of the Members then present approve of it, it shall become part of the Constitution.

BY-LAWS

ADOPTED BY THE BOARD OF MANAGERS.

Article 1.

The Officers of the Board shall be a Chairman, a Secretary, and two Curators.

Article 2.

The Chairman shall preside at the Meetings of the Board ; he shall sign all orders upon the Treasurer of the Institute, when the accounts shall have been passed by the Board ; and shall call special Meetings, whenever he shall receive a written request signed by five Members.

Article 3.

The Secretary shall keep correct records of all proceedings of the Board, subject at all times to the inspection of any of its Members ; he shall notify to every Committee their appointment, through their Chairman, and shall transmit to him any documents relative thereto, within two days after the appointment of the Committee. He shall keep a roll of the Members' names, and at every meeting note the absentees. He shall give notice of every meeting of the Board by printed circulars. He shall lend no document or papers of the Board to any Member thereof, without a receipt. He shall keep a roll of the Members of the Institute, classed according to their occupations ; and it shall also be the duty of the Secretary to attest all orders drawn by the Board.

Article 4.

The Curators shall have charge of all the property of the Institute, except the records, papers and books, which may be assigned to any of its Officers.

Article 5.

The stated Meetings of the Board shall be held on the first Thursday in each month, at six o'clock, P. M. from the stated Meeting in October to that in March, and at 7 o'clock, P. M. during the other months.

Article 6.

The order of business at the meetings of the Board shall be, 1st, reading the minutes; 2d, reports from standing committees; 3d, reports from select committees; 4th, new business; 5th, proposal of candidates; 6th, elections; 7th, calling the roll.

Article 7.

Standing Committees shall be nominated by the Chairman, and approved of by the Board, on—1st, finance; 2d, lectures; 3d, library; 4th, cabinet of models; 5th, the mineralogical collection; 6th, premiums and exhibitions: each to consist of five members.

Article 8.

It shall be the duty of the Standing Committees to keep regular Minutes of their proceedings, and to report them Monthly to the Board.

Article 9.

Committees on the examination of any new Machine or Invention which may be offered, shall be appointed in the following manner: the Chairman of the Board shall nominate one of the members thereof, who, when approved of, shall act as Chairman of the Committee; and the other Members of the Committee shall be nominated and elected by the Board from any Members of the Institute.

Article 10

All other select Committees shall be nominated in the following manner: the Chairman shall nominate to the Board the

Chairman of the Committee, who shall name a second Member, and he a third, &c. until the whole number be filled, a vote being taken upon each.

Article 11.

All special Committees must report to the Board within a month after their appointment, otherwise they shall be considered as discharged, and a new committee appointed.

Article 12.

The annual contributions of Members shall become due and payable on the third Thursday in January of each year, and all new members shall be charged with dues from the commencement of the year in which they shall be elected.

[*Extract from the Minutes of the Board for February 26th, June 10th and 24th, and July 8th*, 1824; *and January 6th*, 1825.]

Officers of the Franklin Institute for 1824.

PRESIDENT.

James Ronaldson.

VICE-PRESIDENTS.

Mathew Carey, Isaiah Lukens.

RECORDING SECRETARY.

William Strickland.

CORRESPONDING SECRETARY.

Peter A. Browne.

TREASURER.

Thomas Fletcher.

MANAGERS.

1 Paul Beck, jr.
2 Thomas Leiper,
3 John Harrison,
4 Thomas Gilpin,
5 Samuel R. Wood,
6 Henry Horn,
7 William H. Keating,
8 J. Katez,
9 Daniel Groves,
10 John Haviland,
11 Samuel V. Merrick,
12 William Abbott,
13 John D. Eisenhut,
14 David H. Mason,
15 John P. Wetherill,
16 Clement C. Biddle,
17 James J. Rush,
18 James Clark,
19 Abraham Miller,
20 M. T. Wickham,
21 James Harper,
22 Joseph Cloud,
23 Adam Ramage,*
24 Harvey Lewis.†

* Elected in the place of *John C. Browne*, resigned.
† Elected in the place of *Robert Patterson*, deceased.

LIST OF MEMBERS.

A

Agnew, John	*Fire-Engine maker*
Astley, Thomas	*Merchant*
Abbott, William	*Brewer*
Adams, William	*Teacher*
Atkinson, Asher	*Saddler*
Allen, James	*Plasterer*
Ayres, Jonathan D.	*Teacher*
Alexander, Samuel	*Merchant*
Allen, William	*Do.*
Alexander, Thomas A.	*Do.*
Albertson, Benjamin	*Do.*
Alberger, W. A.	*Plumber*
Allison, Richard	*Marble Mason*
Allen, John	*Merchant*
Ashton, John, jr.	*Clothier*

B

Beck, Paul, jr.	*Shot Manufacturer*
Bald, Robert	
Brown, Frederick	*Druggist*
Brown, Moses	*Merchant*
Browne, Peter A.	*Counsellor*
Budd, Samuel	*Blacksmith*
Bancker, Charles N.	*Merchant*
Birch, William Y.	

Biddle, Clement C.	*Notary Public*
Baldwin, M. W.	*Machinist*
Bull, Marcus	*Gold Leaf Manufacturer*
Baker, James	*Merchant*
Brown, David Paul	*Counsellor*
Browne, John C.	*Smith*
Biddle, Joseph	
Biddle, Nicholas	*President U. S. Bank*
Baker, Newsom	*Carpenter*
Burden, Joseph	*Chairmaker*
Barnard, J. S.	
Bladen, William T.	*Biscuit Baker*
Blake, George E.	*Music Composer*
Barry, Joseph B.	*Cabinet Maker*
Beck, William C.	*Paper Hanging Manufac.*
Baker, Benjamin F.	*Watchmaker*
Bradford, Samuel F.	*Bookseller*
Blight, George	*Merchant*
Brashears, Samuel	*Attorney at Law*
Baker, Samuel	*Carpenter*
Brader, Jacob	
Brown, Thomas, jr.	
Butner, Edward J. T.	
Brewer, John M.	*Teacher*
Biddle, James	*Capt. U. S. N. Life Member*
Broom, James M.	*Counsellor*
Burt, Nathaniel	*Merchant*
Biddle, James C.	*Attorney at Law*
Blanchard, J. W.	*Paper Hanging manufac.*
Bacon, John	*City Treasurer*
Beatty, John	*Paper Hanging manufac.*
Beck, Henry P.	*Attorney at Law*
Boyd, William	*Merchant*
Biddle, Thomas	*Stock & Ex. Brok. Life Member*
Bedell, G. T. Rev.	
Budd, Thomas A.	*Attorney at Law*
Brown, David S.	*Merchant*
Bradford, Thomas, jr.	*Counsellor*

Bache, Richard	*Post Master*
Brown, James	*Cordwainer*
Blackmore, Thomas V.	*Japanner*
Bridport, Hugh	*Artist*
Bullock, Benjamin	*Skin-dresser*
Bowler, Daniel B.	*Jeweller*
Breck, Samuel	*Agriculturist*
Barron, James	*Captain U. S. Navy*
Bonaparte, Charles	
Bulkley, James H.	*Hatter*
Black, James	*Jeweller*
Binney, Horace	*Counsellor, Life member*

C

Childs, C. G.	*Engraver*
Carey, Mathew	
Carey, Henry C.	*Bookseller*
Caldcleugh, R. A.	
Cooper, Robert	*Carpenter*
Colton, Oren	*Shuttle maker*
Campbell, Hugh	*Plumber*
Clarke, George M.	*Machinist*
Crooks, George R.	*Currier*
Coston, B. P.	*Pattern & Model maker*
Carter, Joseph	*Nail Manufacturer*
Christie, William	*Upholsterer*
Curtis, John	*Brass Founder*
Coxe, John R., M. D.	*Professor of Materia Medica*
Cloud, Joseph	*Refiner at the Mint*
Clark, James	*Carpenter*
Clark, John	*Chairmaker*
Camm, William	*Hatter*
Crissy, James	*Bookseller*
Crozer, James G.	*Merchant*
Cox, James	*Teacher*
Clark, Joseph	*Cotton Manufacturer*
Cope, Marmaduke C.	*Merchant*
Cope, Caleb, jr.	*Do.*
Carvill, Henry	*Gold Leaf manufacturer*

Clarke, Alexander H.	*Merchant*
Craig, William	*Do.*
Cox, John	
Cook, Elisha W.	*Turner*
Clark, Benjamin W.	*Watchmaker*
Clarke, Edward	
Condy, J. W.	*Counsellor*
Coryell, Henry L.	*Carpenter*
Camac, Turner	
Cresson, Elliott	*Life Member*
Connelly, John	
Coffin, Hector	*Merchant*
Cadwalader, Thomas, Gen.	
Carter, Durden B.	*Merchant*
Carr, Robert	*Agriculturist*
Cheever, Benjamin R.	*Merchant*
Cornelius, Christian	*Lamp manufacturer*
Collins, Zaccheus	*Life Member*
Carpenter, George W.	*Chemist*
Cox, Daniel W.	
Conard, John	*U. S. Marshal*
Conard, Charles	*Carpenter*
Campbell, John	*Smith*
Cooper, John	*Merchant*
Carmalt, Caleb	*Conveyancer*

D

Drake, Alfred	*Druggist*
Droz, Charles A.	*Watchmaker*
Dialogue, Adam	*Fire Hose maker*
Desilver, Robert	*Bookbinder*
Donaldson, Joseph	*Hatter*
Duhring, Henry	
Dickinson, John	*Watchmaker*
Dowers, John	*Distiller*
Dupont, E. J.	*Powder Manuf. Brandywine*
Dewees, William P., M. D.	
Duncan, Benjamin	*Wood Corder*
Dougherty, James	*Tailor*

Darrach, William, M. D.	
Drayton, John	
Dietz, Rudolph	
Darrach, Thomas B.	*Fur Merchant*
Duncan, Stephen	*Agriculturist*
Dundas, James	*Counsellor*
Dupont, Victor	*Cloth Manufac. Brandywine*
Dupont, Charles	*Do. do. do.*
Dickson, John W.	*Accountant*
Dilworth, Charles	*Merchant*
Davis, Anthony	*Skin Dresser*
Donaldson, Isaac	*China Merchant*
Duncan, William	*Merchant*
Davis, Samuel, Col.	*Delaware*
Dorsey, Edward G.	*Printer*
Duncan, Thomas	*Judge of the Supreme Court*
Dallas, George M.	*Counsellor*
Desmond, Daniel J.	*Attorney at Law*
Dunlap, Thomas	*Attorney at Law*
Douglass, John	*Sheriff*
Donnaldson, E. M.	*Sea Captain*

E

Eisenhut, John D.	*Coppersmith*
Ellmaker, Levi	*Merchant*
Eckfeldt, Adam	*Coiner at the Mint*
Emery, Samuel	*Wax Bleacher*
Earle, James	*Gilder*
Edwards, William	*Painter*
Evans, Oliver	*Iron Founder*
Erdmann, Daniel R.	*Carpenter*
Erdmann, Henry	*Do.*
Ewing, Henry	*Apothecary*
Emerson, G., M. D.	
Evans, Charles	*Blacksmith*
Espy, James P.	*Teacher*
Evans, Charles	*Druggist*
Evans, Thomas	*Do.*

Ellis, William H.	
Emory, Thomas B.	*Cabinet maker*
Elkinton, George W.	*Tallow-chandler*

F

Fletcher, Thomas	*Silversmith & Jeweller*
Fairman, Gideon	*Engraver*
Fry, William	*Printer, Life Member*
Ford, Robert M.	*Copper-plate Printer*
Fraley, Frederick	*Baker*
French, Benjamin F.	
Freeland, John T.	*Machinist*
Finley, Anthony	*Bookseller*
Ford, Jesse	*Carpenter*
Fisher, Joseph	*Optician*
Fowle, Nathaniel	*Hatter*
Fraley, John U.	*Baker, Life Member*
Frick, Jacob	*Printer*
Fales, George	*Merchant*
Fox, George	*Attorney at Law*
Freed, George F.	*Looking-glass silverer*

G

Garrigues, Isaac B.	*Marble Mason*
Garrigues, William, jr.	*Carpenter*
Griffith, Robert E., M. D.	
Gallagher, David, M. D.	
Gleason, Jonas	*Stove-maker, Life Member*
Gilpin, Thomas	*Paper-maker*
Graff, Charles	*Merchant*
Gray, Samuel N.	*Brewer*
Groves, Daniel	*Bricklayer*
Gaul, Frederick	*Brewer*
Gordon, Thomas F.	*Attorney at Law*
George, Joseph	*Currier*
Graham, Samuel	
Gardner, William	

Gibson, William, M. D.	
Garratt, John	*File Cutter*
Gaudichaud, Peter	*Jeweller*
Garrett, William E.	*Snuff Manufacturer*
Garrigues, Edward, jr.	*Merchant*
Gill, John	*Dyer*
Goodman, George	*Printer*
Graham, James	
Gardiner, Sidney	*Silversmith & Jeweller*
Gardiner, Baldwin	*Merchant*
Garrett, Philip	*Watchmaker*
Gerhard, William	*Hatter*
Godman, J. D., M. D.	
Griffith, W. V.	*Cabinet-maker*
Grice, Samuel	*Ship-builder*
Gilliams, Jacob	*Dentist*
Garrigues, James R.	*Marble mason*
Gardette, James	*Dentist*
Goldsborough, Charles H	
Grimes, John	
Gratz, Joseph	*Merchant*
Glasgow, James	*Plasterer*
Govett, William	*Carpenter*
Gaul, Frederick, jr.	*Brewer*
Gibson, James	*Counsellor*
Gibson, John B.	*Judge of the Supreme Court*

H

Harrison, John	*Operative Chemist*
Hyde, George	*Bookbinder*
Harley, George	*Coppersmith*
Hamelin, Joseph P.	*Printer*
Haviland, John	*Architect*
Horn, Henry	*Silver Plater*
Harding, Jesper	*Printer, Life Member*
Hays, Isaac, M. D.	
Haines, Reuben	*Agriculturist*
Howell, Benjamin B.	*Merchant*

Hansell, William S.	*Saddler*
Hocker, Christopher M.	*Marble mason*
Hays, James, jr.	*Carpenter*
Hancock, William C.	*Merchant*
Herkness, Adam	*Marble mason*
Hollinshead, Edmund	*Merchant*
Hubbs, Paul K.	*Do.*
Harper, James, jr.	*Brick maker*
Hamer, John	*Teacher*
Hughs, Thomas	*Do.*
Hertzogg, Peter	*Sugar refiner*
Halloway, Thomas	*Steam-engine maker*
Hare, Robert, M. D.	*Professor of Chemistry*
Hufty, Samuel	*Engraver*
Howe, Jedediah	
Hurley, Michael, Rev.	
Haswell, David	*Painter & Glazier*
Hulme, Thomas	
Huber, James S.	*County Treasurer*
Hewett, William	
Hood, William	
Haven, Joshua	*Merchant*
Hacker, Isaiah	*Do.*
Hinchman, Benjamin M.	*Do.*
Hutchinson, James	*Carpenter*
Haley, Nathan	*Paper Hanging manufac.*
Haseltine, John	*Merchant*
Haines, Ephraim	*Lumber merchant*
Hacker, Jeremiah	*Merchant*
Hillborn, Cyrus	
Hunt, Uriah	*Bookseller*
Hollinshead, Benjamin M.	*Merchant*
Hall, Wilfred	*Organ builder*
Hutton, Abraham B.	*Teacher*
Holt, Eleazer	
Hart, John S.	*Druggist*
Hughes, Samuel	*Carpenter*
Hayden, William	*Chair-maker*

Harmstead, Lawrence	*Carpenter*
Hopkins, Howell	*Counsellor*
Hutchinson, Randall	*Prothonotary District Court*
Hillyard, Abraham	

I & J

Ingraham, Edward D.	*Counsellor*
Ireland, Alphonso C.	*Carpenter & Surveyor*
Ingersoll, Joseph R.	*Counsellor*
Jones, William	*Naval Officer*
Jeffries, George	*Coachmaker*
James, John, jr.	*Cabinet maker*
Johnson, John	*Wheelwright*
Jones, Paul	*Paste-board manufacturer*
Jewell, John B.	*Painter & Glazier*
Jackson, Samuel, M. D.	
Johnson, Andrew	*Carpenter*
Johnson, Robert	*Printer*
Jenks, Joseph R.	*Merchant*
Jones, William H.	*Merchant*
James, Thomas C., M. D.	*Professor of Obstetrics*

K

Kneass, William	*Eng. of the Mint, Life Member*
Keating, William H.	*Professor of Chemistry, Life memb.*
Kane, John K.	*Counsellor*
Katez, J.	*Bookbinder*
Kneass, Christian	*Silver plater*
Kinnan, John C.	*Turner and Machinist*
Kennedy, Samuel	*Carver and Gilder*
Kid, Robert	*Copper merchant*
Katez, Michael	*Locksmith and bell-hanger*
Kenworthey, John	*Painter & Glazier, Life Memb.*
Kerr, William	*Rope maker*
Keen, William W.	*Currier*
Kingston, Stephen	
Kearny, Francis	*Engraver*
Ker, John	*Merchant*
Knight, Abel	*China merchant*

V.
19

Kendall, Christopher	*Merchant*
Kennedy, Samuel C.	*Accountant*

L

Lewis, M. D.	*Merchant*
Lang, George S.	*Engraver*
Lukens, Isaiah	*Machinist & Mechanician*
Longacre, James B.	*Engraver*
Lovering, Joseph S.	*Sugar refiner*
Letourno, Clement	*Blacksmith*
Lewis, Harvey	*Silversmith*
Lex, Charles, jr.	*Merchant*
Leiper, Thomas	*Tobacconist*
Lescure, Edward P.	
Lippincott, B. B.	*Hatter*
Long, S. H.	*Major, U. S. Army, Life Memb.*
Launy, Alexander	*Jeweller*
Leib, John R.	*Student of Law*
Laycock, Isaac H.	*Chairmaker*
Lyons, Samuel	*Tinman*
Lowber, John C.	*Counsellor*
Lindsay, Thomas	*Hatter*
La Roche, R., M. D.	
Langstroth, J. G.	*Paper hanging manufacturer*
Linnard, T. M.	*Lumber merchant*
Loud, Thomas	*Piano Forte maker*
Lewis, Mordecai	*White Lead manufacturer*
Lownes, Edward	*Silversmith*
Lammot, Daniel	*Merchant*
Lippincott, William	*Cotton manufacturer*
Linnard, James	*Lumber merchant*

M

Mease, James, M .D.	
Merrick, Samuel V.	*Fire-Engine maker, Life memb.*
M'Euen, Thomas, M. D.	
Mason, David H.	*Machinist and Mechanician*
Mayweg, William	*Merchant*
Mortimer, John	*Bookseller*

Muhlenberg, J. P.	*Iron Founder*
M'Dowell, William S.	*Watchmaker*
Miller, Abraham	*Potter*
Murphy, Arthur	*Bricklayer*
Morris, Thomas W.	*Attorney at Law*
Mentz, George W.	*Bookseller*
M'Allister, John, jr.	*Whip-maker*
M'Alpin, James	
Miller, Clement S.	*Attorney at Law*
M'Minn, Robert	*Blacksmith*
Martin, Prosper	*Steam-Engine maker*
Myers, Isaac	*Painter & Glazier*
Monell, John	*Tailor*
Morris, Stephen P.	*Stove & Grate maker*
Mackey, Daniel H.	
Moss, John	*Life Member*
M'Koy, Robert	*Brand cutter*
Marot, Joseph	*Bookseller*
Macauley, Isaac	*Floor-cloth manufacturer*
Moore, James E.	*Bookseller*
Miles, Jacob	*Ladies shoe-maker*
Mitchell, J. K., M. D.	
M'Donald, S.	*Turner*
Maule, William	*Carpenter*
Mifflin, Lloyd	*Manufacturer*
Manning, Thomas S.	*Printer*
Mercier, Charles	*Confectioner*
Meade, Richard W.	*Merchant, Life Member*
M'Ilhenny, William, jr.	*Attorney at Law*
M'Lanahan, Johnston	*Merchant*
Mustin, Ebenezer	*Japanner*
Morris, Isaac P.	*Druggist*
Morrell, Robert	*Carpenter*
Morton, Samuel G., M. D.	
Morris, George W.	*Brush Maker*
Morris, William	*Turner and Grate maker*
Mingle, John, jr.	*Coach spring and grate maker*
Meredith, William	*Counsellor*

M'Leod, George	*Rope maker*
Milnor, William, jr.	*Counsellor*
Milne, Richard	*Merchant*
Miller, Daniel L.	*Merchant*
M'Kean, Joseph B.	*Judge of the District Court*
Martin, Robert C.	*Saddler*
Mettler, Samuel	*Grocer*
Mickley, Joseph I.	*Piano Forte maker*

N

Newcomb, Hezekiel	*Currier*
Nuttle, Robert E.	*Coach maker*
Nowell, John	*Printer*
North, Richard	*Marble mason*
Nancrede, J. G., M. D.	
Newbold, James S.	*Merchant*
Newhall, Paul W.	*Accountant*
Nyce, Richard U.	
Norris, Joseph P., jr.	*Attorney at Law*
Newcomb, B.	*Attorney at Law*
Neff, John R.	*Merchant*

O

O'Hara, Charles	*Accountant*
O'Neil, John	*Carpenter*
O'Neil, Robert	*Carpenter*
Ogden, John M.	*Do.*
Osborne, George C.	*Colour maker*

P

Powel, John Hare	*Agriculturist*
Patterson, Robert M., M. D.	*Professor of Natural Philosophy*
Peirce, Jacob	*Teacher*
Penington, Edward, jr.	*Sugar Refiner*
Prichett James C.	*Currier*
Patten, John W.	*Tanner*
Parke, Charles B.	*Iron and Brass founder*
Philips, John S.	*Sugar Refiner*

Poole, Edward	*Bookseller*
Peters, Richard, jr.	*Counsellor*
Pryor, Daniel	*Carpenter*
Plantou, A.	*Dentist*
Pearce, John	*Plumber.*
Pomeroy, Benjamin F.	*Turner*
Pool, Daniel	
Prevost, Andrew M.	*Stock & Exchange Broker*
Pedriaux, Lawrence	*Jeweller*
Palmer, Thomas H.	*Printer*
Packer, Edward	*Brass founder*
Pratt, H. C.	
Pennock, Casper W.	*Agriculturist*
Pemberton, John	*Merchant*
Pippitt, Isaac	*Cabinet-maker*
Persico, Lewis	*Sculptor*
Poulson, Zachariah	*Printer*
Partenheimer, Adam	*Brewer*
Page, James	*Attorney at Law*
Peirce, Charles W.	*Merchant*
Pugh, Isaac	*Bookseller*
Persico, George	*Artist*
Pearson, Thomas J.	*House Carpenter*
Peale, Charles W.	
Peddle, William A.	*Oak cooper*
Purdon, John	*Counsellor*
Pearson, Henry B.	*Attorney at Law*

R

Ronaldson, James	*Cotton manufacturer, Life Member*
Ronaldson, Richard	*Type Founder*
Rowland, William	*Saw Manufacturer*
Rowley, Horatio G	*Plumber*
Richards, Mark	*Iron Founder*
Riehle, Henry J.	*Tanner*
Robb, Charles	*Draper*
Ramage, Adam	*Printing-press maker*
Roberts, Israel	*Coppersmith*

Richardson, John	*Bookseller*
Riggs, William H. C.	*Clock and Watchmaker*
Ross, Aaron	*Saddler*
Roberts, John	*Accountant*
Robbins, Benjamin	*Carpenter*
Rush, William	*Carver*
Rowland, James, jr.	*Steel manufacturer*
Ralston, A. G.	*Merchant*
Robbins, Samuel J.	*Do.*
Rea, John	*Upholsterer*
Ralston, Gerard	*Merchant*
Rogers, James	*Do.*
Roberts, A. S.	*Druggist*
Ralston, Robert	*Merchant*
Rogers, Solomon A.	*Scale-beam maker*
Robinson, William	*Hatter*
Richards, William	*Lime burner*
Read, James	
Rush, James J.	*Steam-engine maker*
Ridgway, Joseph	*Tailor*
Read, Alexander	*Dealer in China*
Richards, Benjamin W.	
Roach, Isaac	*Lumber merchant*
Randall, Archibald	*Attorney at Law*
Riter, George W.	*Recorder of Deeds*
Raybold, Joshua	*Prothon. of the Supreme Court*

S

Spenser, Asa	*Mechanician and machinist*
Smith, George W.	*Attorney at Law*
Stewart, Samuel M.	*Stationer & paper hanging manufac.*
Senneff, Jacob	*Reed & Shuttle maker*
Struthers, John	*Marble mason*
Strickland, William	*Architect and engineer*
Somerville, James	*Iron founder*
Stackhouse, Powell	*Carpenter*
Simmons, John	*Tin-plate Worker*
Skerrett, Joseph R. A.	*Printer*

Sullivan, John T.	*Bookbinder*
Simpson, James	*Comb maker*
Snowden, Thomas	*Surgeon's Instrument maker*
Sulger, Christian	*Baker*
Schreiber, Thomas	
Straley, Frederick	*Saddletree maker*
Schreiner, Joseph H.	*Hardware merchant*
Smith, Joseph H.	*Accountant*
Smith, Job R.	*Colour maker*
Savary, William	*Lumber merchant*
Savary, Thomas	*Do.*
Stockman, Jacob	*Silver thimble maker*
Small, Richard M.	*Bookseller*
Shelmerdine, Edward	*Hatter*
Stegagnini, L.	*Sculptor*
Stancliffe, Benjamin	*Mathematical Instrument maker*
Schrader, John H.	*Turner and Machinist*
Smith, Daniel B.	*Druggist*
Smith, Daniel	*Carpenter*
Starr, Isaac	*Merchant*
Seyfert, John H.	
Sansbury, Horatio, M. D.	
Stevenson, Cornelius	*Accountant*
Smith, Richard Penn	*Attorney at Law*
Smith, William	
Stewardson, George	*Merchant*
Swaim, William	
Stone, Dexter	*Merchant*
Stewart, William	*Attorney at Law*
Schively, Henry	*Surgeon's Instrument Maker*
Salmon, H. R.	
Smith, Stevenson	*Printer*
Snowden, Isaac C., M. D.	
Shaw, Henry P.	*Artist*
Soulié, Bernard	*Do.*
Spackman, George	*Student of medicine*
Scattergood, Thomas	*Tanner*
Steel, James, jr.	*Engraver*

Smith, Seth	*Teacher*
Smith, Benjamin	
Sarchett, John F.	*Stove maker*
Stewart, John A.	*Ornamental Painter*
Simpson, Henry	*Merchant*
Sellers, Charles	*Wire manufacturer*
Sellers, George Escol	
Smith, Edward A.	
Siddall, Joseph	*Cotton manufacturer*
Steinhaur, Daniel	
Schlatter, William	*Merchant*
Simmons, Samuel R.	*Lumber merchant*
Schlag, John	*Sugar refiner*
Steel, John,	*Weaver*
Sergeant, John	*Counsellor*
Scott, John M.	*Counsellor*
Smith, Kenderton	*Attorney at Law*
Sykes, Robert W.	*Attorney at Law*
Simpson, Samuel	*Skindresser*
Stout, Jacob C.	*Hatter*
Sharp, Lodwycke	
Shelmerdine, Jacob	*Carpenter*

T

Tresse, Thomas K.	*Carpenter*
Truman, Joseph M.	*Tinplate worker*
Truman, George	*Tanner*
Taylor, Thomas	*Currier*
Tucker, Benjamin	*Teacher*
Tennent, John	*Corset maker*
Thackara, Samuel	*Plasterer*
Tyler, Rufus	*Mechanician & Machinist*
Toland, Robert	*Merchant*
Troth, Henry	*Druggist*
Tryon, G. W	*Gunsmith*
Tascor, Thomas T.	*Coppersmith*
Thompson, Jonah	*Nail manufacturer*
Taylor, Benjamin	*Brush maker*

Todhunter, Joseph	*Hosiery and Glove merchant*
Tilghman, William	*Chief Justice of Pennsylvania*
Thomas, Jacob	*Tailor*

U & V

Underwood, Thomas	*Engraver*
Vaughan, John	*Merchant*
Vanhorn, M. K.	*Carver*
Vaux, Roberts	
Vanharlingen, John M.	*Merchant*

W

Wood, Samuel R.	*Tanner*
Wickham, M. T.	*Manufac. of Arms*
Whitaker, James	
Winebrener, D.	*Draper*
Wetherill, John Price	*Operative Chemist*
Watson, C. C. jr.	*Draper*
Wetherill, Charles	*Druggist*
Wetherill, Samuel	
Watson, J. W.	*Draper*
Watson, Henry R.	*Do.*
Walmsley, William M.	*Stock Broker*
Wickersham, John	
White, Charles H.	*Cabinet maker*
Warner, William	
Watson, Joseph	*Mayor of the City*
Wood, James B.	*Wheelwright*
Wilson, George	*Leather manufacturer*
Wright, Aaron P.	*Merchant*
Warder, William S.	
Wood, Samuel C.	
Wood, David C.	
Wilson, David	
Wilson, William S.	
Woods, Daniel	*Livery Stable-keeper*
Waln, Lewis	*Merchant*

Willits, John H.	*Teacher*
West, Robert	*Cabinet maker*
Wilkins, Jacob F.	
Wharton, Thomas I.	*Attorney at Law*
Wharton, John	*Stock and Exchange Broker*
Warner John	*Watch-case maker*
Waddel, Robert	*Carver*
Wucherer, John R.	*Merchant*
West, James	*Merchant*
Ware, John T.	*Ship Carpenter*
Warder, John W.	*Merchant*
Warder, Jeremiah	*Merchant*
Williams, Henry J.	*Attorney at Law*
Wickersham, Thomas	*Merchant*

Y

Yardley, William, jr.	*Merchant*
Young, Andrew	*Cotton manufac.*
Yard, John, jr.	*Button and Ivory comb maker*
Young, William J.	*Mathem. Instrument maker*
Young, William S.	*Mathem. Inst. maker*
Yerkes, Titus	*Inn-keeper*

HONORARY MEMBERS.

John Franklin Caruthers, A. B. President of the Franklin Society, Lexington, Virginia.

Edward Graham, Esq. Professor of Natural Philosophy, Washington College, Lexington, Virginia.

John Griscom, Professor of Chemistry, &c. New York.

Samuel Parkes, F. L. S. of London.

FIRST QUARTERLY REPORT,

MADE TO THE INSTITUTE, AT A MEETING HELD APRIL 15, 1824.

To the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts.

The Board of Managers, in pursuance of Article V. Section 3, of the Constitution, offer their first Quarterly Report of the Transactions of the Board.

Within three days after their election, your Board met and organized themselves, by the election of ROBERT PATTERSON, Esquire, as their Chairman, and WILLIAM STRICKLAND as their Secretary.

A Committee was appointed to prepare By-Laws, which, after having been submitted to the Board, were adopted, and of which a copy is hereto annexed.

The necessity of obtaining a charter of incorporation without delay, and the advanced stage of the session of the General Assembly, induced your Board to lose no time in applying for an Act to this effect, which, they have great pleasure in stating, was granted previous to the adjournment, and which, from the copy now presented to the Institute, will be found to embrace every object which the Society might wish for, and to leave it unshackled in the adoption of any measure that may hereafter appear conducive to the advantage of the Institute.

Your Board have found with great pleasure, that as the objects of the Society became generally known, they met with the approbation of the community at large, of which a flattering evidence will be found in the annexed list of the members; and from the number that have desired their names to be inscribed on the list of candidates, and whose election is necessarily postponed until the next meeting of the Board, there is every reason to expect a great and rapid increase in the number of members.

Your Board have been anxious to commence immediately the usefulness of the Institute, by the establishment of popular lec-

tures during the present season; but as the funds of the Society are still very low, they have had recourse to the zeal of their members, and are happy to state that the Introductory Lecture, which will be delivered on Wednesday, the 28th instant, by Dr. Robert M. Patterson, will be followed by volunteer lectures, to be delivered by some of the Members, every Wednesday evening, at seven o'clock, and to these the attention of the Members is earnestly called.

An object of equal, if not of greater importance than the preceding, is that of public exhibitions, to which all the products of national industry may be sent; the effect and consequence of such exhibitions will necessarily be to extend the reputation of the Institute, to stimulate the zeal of the members, and to excite a proper degree of emulation and of justifiable rivalry among the numberless manufacturers and mechanics of this city. It is confidently believed that when the products of our industry are collected from the various workshops now dispersed throughout the city and state, and exhibited together, they will form a collection calculated to excite a gratifying sense of pride in the bosom of every well-wisher to the prosperity of our manufactures, and an encouraging hope that, under proper regulations, we may soon compete with foreigners in the manufacture of all useful articles.

By bringing together the various products of our workshops, we shall soon discover what manufactures flourish in the country,—what objects are successfully prepared by our mechanics,—and in what respects they are deficient. Great as is the merit of new inventions, your board is convinced that to attain perfection of workmanship in old established inventions, is an object of at least as great importance; and hence, the principle, which they have adopted as the basis of the exhibition to which they now invite your attention, is, that perfection in workmanship is to be encouraged, as well as novelty in invention. But to obtain perfection of workmanship necessarily requires that a sufficient time should be allowed to the mechanic to prepare with care those objects which he wishes to submit to the scrutinizing eye of the public. Under this impression, and with a view of holding the exhibitions at that time of the year when the great-

est concourse of strangers in our city can be expected, the Board have resolved that the exhibitions shall be held at the time of the Quarterly Meeting in October of every year.

The plan of the exhibition to be held in October next, as well as the conditions under which the articles may be deposited on that occasion, at present occupy the attention of your Board, and as soon as they shall have been prepared, they will be communicated to the public through the medium of the papers.—Your Board beg leave, most earnestly, to submit to the Institute the necessity of every Member's using his efforts to give popularity and renown to the exhibition, by sending to it objects of his own manufacture, or by calling to it the attention of those whose products would, in his opinion, be honourable to the country.

As connected with this subject, the Board wish to call your attention to that provision of the Constitution, which declares that they shall examine all new inventions submitted to them. Your Board would have found themselves unable to do justice to this subject, unless they had adopted that By-Law which allows them to appoint Committees from the Society at large, for the examination of new machines or inventions. In the performance of this useful and interesting task, the Board flatter themselves that they will meet with the cordial assistance of every Member of the Society.

Several machines have already been laid before them, upon which it is expected that detailed reports will be made—of these the Board will take measures to submit to the Society all such as may appear of general interest.

Among the objects which your Board have in immediate contemplation, are the following, viz:—

1. The obtaining of a suitable room for the meetings of the Institute. 2. The formation of a Library. 3. The creation of a Cabinet of Minerals and Models of Machines.

In the execution of these plans, as much economy as possible will be used, for the funds of the Society are still in their infancy; but they flatter themselves that by the liberality of the members in particular, and of the public at large, the expense attending the formation of a library will be considerably reduced.—

To avoid all unnecessary expenditures, the Library and Cabinet shall be placed under the control of Curators, who, being Members of this Board, will attend to this duty without any compensation, and thereby a saving of considerable importance to the Society in its origin will be effected. The Board have to acknowledge, that a liberal spirit towards the Library has already been manifested by several Members, who have promised to assist in its formation. The Curators elected for the present year are David H. Mason and Samuel V. Merrick.

The Corresponding Secretary has, at the request of the Board, notified the formation of the Institute to all similar Societies known to your Managers; and it is intended that an active correspondence shall be kept up with all persons able to further the views of the Institute. As it is important that the Members should be made acquainted, as soon as possible, with all new inventions made throughout the Union, measures have been taken by the Board, to obtain, as early as possible, a list of the patents granted in the city of Washington; and whenever the importance of the subject will warrant it, copies of the specifications upon the most reasonable terms will be procured.

There are objects of still greater importance, which the Board entertain a hope may at some future day be within the means of the Society; foremost among these would be the establishment of an Experimental Workshop and Laboratory, for the better instruction of Members by the results of experience: but this would require a much larger sum of money than the Society has at present at its disposal. All that your Board will therefore venture to suggest on this subject is, that the Society should not lose sight of it, but embrace the first opportunity of stamping upon their Institution the greatest degree of usefulness, by the creation of such an experimental school.

Perhaps a measure of equal importance would be the publication of a Journal, on the plan of that lately commenced in London, and of which it is said that one hundred thousand copies are sold in London and its immediate vicinity. No doubt can exist that such a Journal would diffuse among our mechanics, at a low rate, much useful information; that it would contribute to make known, without delay, the improvements of our artists, and

by securing to them the merit of their discoveries, would afford them both wealth and reputation. But it cannot be doubted, that the establishment of such a Journal at this time would be premature, and that it might involve the Society in difficulties, which it is peculiarly desirable to avoid at the origin of our Institution.

In the meanwhile, as the first step towards the attainment of this object, your Board would call your attention to a Journal of this kind, which is proposed to be published under the direction of one of the officers of the sister Society, in the City of New York. Next to achieving ourselves a desirable object, the best measure is to encourage the efforts of others. Nothing can promote our views more effectually, than those undertakings which have a tendency to disseminate knowledge, whatever may be the source from which they proceed.

The report of the Treasurer, hereto annexed, will show you that active measures have been taken to collect the dues from the Members. This course has been judged to be useful, not only to the Society, but also to the individuals that compose it. By suffering their contributions of this year to remain unpaid, the Members would but increase the difficulty of meeting that of the next year. Hence, such of you as have not yet been called upon, are requested to prepare yourselves to pay immediately a contribution, which, small as it is at first, might by accumulating it for several years, become a burthen.

The expenses will be found to have been but inconsiderable as yet. The Board wish to accumulate their funds, and mature their plans before they incur any expense.

The importance of creating a permanent fund, to meet the future exigencies of the Institution, has been felt by the Board; and with a view to this effect, they have passed a resolution expressive of their belief in the expediency of the measure, and authorizing the Treasurer to purchase stocks, bearing interest, to the amount of two hundred dollars; and in order that no opportunity of improving the funds of the Society should be overlooked, a further sum of three hundred dollars has been deposited in the hands of the Philadelphia Saving fund Society. Thus all the funds of the Institute will be disposed of in a profitable

manner, with the exception of a small balance kept in the hands of the Treasurer to meet current expenses.

The Board have annexed to this Report a copy of the Constitution, with such verbal corrections as were reported to them by the Committee appointed to revise its phraseology, at the meeting of the Society on the 5th of February last.

In conclusion, your Board beg leave to state, that a vacancy in their body having occurred, by the resignation of John C. Browne, of Kensington, whose distance from the place of meeting, rendered it inconvenient for him to join the Board, they have by virtue of Art. X. Sect. 3, of the Constitution, elected Adam Ramage, (a Member of the Institute,) to fill Mr. Browne's place.

All which is respectfully submitted by

R. PATTERSON, *Chairman.*

WILLIAM STRICKLAND, *Secretary.*

Philadelphia, April 15, 1824.

SECOND QUARTERLY REPORT,

MADE TO THE INSTITUTE, AT A MEETING HELD JULY 15, 1824.

To the Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts, the Board of Managers offer their second quarterly Report.

Since the last meeting of the Institute, the Board have been frequently convened, for the purpose of carrying into more immediate operation the views of the Institute.

Three objects have principally received their attention—viz. the Lectures, Models, and Exhibitions.

The first, which was the establishment of lectures, has, it is thought, fully developed the importance of an institution of the nature of ours. A preliminary course or series of lectures, on unconnected subjects, has been delivered every Wednesday evening, during the last three months; it has been well attended, and has given general satisfaction. With a view to give a character of permanency to the Institute, the Board have determined upon the creation of four Professorships, viz.

Of Natural Philosophy.

Of Mineralogy and Chemistry, as connected with the Arts and manufactures.

Of Architecture, and

Of Mechanics.

Two of these chairs have been filled, by the election of William H. Keating and William Strickland, Esquires, as Professors of Mineralogy and Chemistry, and of Architecture. It is confidently believed, that the plan which the Board are now maturing, and which will soon be made public, will, by ensuring three courses of lectures, during the ensuing winter, lay the foundation of a permanent accession of Members. From the general attendance of Members during a season of the year, of all others the most unfavourable for lectures, the Managers anticipate that great interest will be taken in the winter lectures. The object of the Professorships is to ensure a certain number of lectures every year, upon those branches which your Board deem of more

immediate interest to the Members, and at the same time to induce the gentlemen, to whom they are intrusted, to devote more time to them than could be expected from the mere zeal of Volunteer lecturers. Your Board are aware that these by no means include all the branches which it would be desirable to have taught in the Institute; but the plan is as comprehensive as in the present state of our finances, it would be prudent to make it.

In order to afford to the lecturers an opportunity of developping the subjects of their lectures to advantage, the Board have ordered the commencement of a collection of Models; and have appropriated to this important object, four hundred dollars, a considerable part of which is to be taken out in life Memberships, so that the draughts upon the Treasury, will probably not exceed one half that amount. The Models now in preparation, refer principally to Architecture and Mechanics.

The object, which the Board have found most difficulty in maturing, was the plan of the exhibition to be held on the eighteenth of October next. From the Address to the manufacturers and mechanics of the union, and the list of premiums proposed, which have already been published, and of which a copy is herewith submitted, the views of the Board will be so apparent, as to require no further comment at present. A plan for the exhibition is now before the Committee on premiums and exhibitions, and as soon as it shall have been matured, care will be taken to give it the greatest possible degree of publicity.

The Board hope that the Members of the Institute will exert themselves to give publicity to the plan, and value to the exhibition, by sending to it all objects of American manufacture, that will be thought worthy of being brought before the public. The plan which the board have adopted, not to admit any of the Managers as candidates for premiums, and also to withhold them from Members of Committees of examination, in those cases upon which they may have to decide, will, it is hoped, ensure the confidence of the public, and secure the impartiality so much to be desired on such an occasion.

With a view to give the required activity to the standing Committees of the Board, that on Models and Minerals has been divided, and Committees of five Members appointed upon each of

these objects. From the very liberal offers of Minerals, which have been made by several Members, hopes are entertained, that as soon as suitable apartments, for the reception of the Museum, shall have been obtained, the cabinet will immediately become interesting and useful.

The great desideratum, thus far, has been the obtaining of a suitable room for the accommodation of the Institute. If the application made to the city Councils, should be favourably received, the accommodation will be such as the friends of the Institute might desire.

The increase of Members, during the last quarter, has been as great as our most sanguine expectations could have anticipated; sixty-six Members have been elected within that period; the greater part of whom, have paid their first yearly contribution in advance, with a view to take advantage of the lectures.

A number of machines have already been submitted to your Board, for reference to special Committees; upon several of these, Reports have been made, which have, in most cases, proved, that these inventions were new, and likely to prove beneficial to the public, as well as creditable to their authors. The Board are at present engaged in preparing a rule of conduct, which will enable them to communicate to the Members at large, the knowledge of these inventions, but in such a manner, and with such restrictions, as shall secure to the inventors all their rights, and all the credit to which they may be justly entitled.

The quarterly Report of the Treasurer, hereto annexed, will exhibit the state of the funds, from which it will appear, that but little money has as yet been disbursed, while active measures have been taken to collect the dues from the Members, and to apply them in some profitable fund, until the disposal of them shall be called for.

All which is respectfully submitted, on behalf of the Board, by

JAMES RONALDSON, *Chairman Pro. Tem.*

WILLIAM STRICKLAND, *Secretary.*

Philadelphia, July 15, 1824.

THIRD QUARTERLY REPORT,

MADE TO THE INSTITUTE AT A MEETING HELD OCTOBER 21, 1824.

To the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, the Board of Managers offer their Third Quarterly Report.

Your Board have devoted their attention to the various important objects confided to them, and present the result of their labours under three distinct heads, viz:—First, Lectures—second, Collections—third, Exhibition. With a view to establish a regular system of Lectures, it has been resolved that the Winter Courses should commence on Monday, the 1st of November, and be continued on the evenings of every Monday and Saturday, at half past seven o'clock, precisely. The courses to continue until the 15th of March. The Saturday evenings will be reserved for the Lectures on Chemistry. The Monday evenings will be devoted to Lectures on Architecture and Mechanics, alternately. The same regulations that existed last Spring, with respect to the admission of the sons and apprentices of members to lectures, have been continued. Members may therefore provide themselves with tickets for the younger persons in their families, at the rate of one dollar each, for the winter. These tickets, as well as those of the members, may be had on application to the Treasurer, Chesnut-street. Arrangements having been made for the commencement of the lectures punctually at the hour prescribed, it is respectfully suggested to those who propose to attend them, that they be early in their attendance, as those who come late, besides losing part of the lecture, necessarily interrupt the lecturer.

In order to allow to the Professors on Mechanics and Architecture, an opportunity of exemplifying the subjects of their lectures by models, measures have been taken by your Board to expedite the preparation of them, and it is hoped, that a sufficient number will be obtained to enable the Professors to do

justice to the tasks assigned to them. The exhibition, which has just closed, has been, it is believed, attended by a sufficient number of the members of the Institute, and of the public at large, to enable them to perceive the immense advantages which will accrue from the system of annually uniting the products of our manufacturers, mechanics and artists, and bringing them altogether before the public. The imperfections which attended the first exhibition proceeded, it is believed, from inexperience, and from the hurry in which it was got up. The public have expressed their indulgence for the deficiencies accruing therefrom. It is believed that no person, who visited the room, left it without a feeling of honest pride, at the extent and perfection which our manufactures have already attained. As the various committees appointed to judge of, and report upon the merit of the articles exhibited, have not yet prepared their reports on the same, it would be premature in us to offer any comments on the merit of the many articles that were sent. It is expected that the premiums will be awarded on Thursday, the 28th instant, at half past four o'clock; and it is contemplated that a detailed report of the whole of the proceedings, and a designation of all the articles exhibited, will be published as soon as possible. The first fruit of this exhibition has been a considerable accession to the list of the members of the Institute. Independent of five members elected during the course of the quarter, eighty-five have been proposed and elected since the commencement of the exhibition, making an aggregate of ninety members since July last.

The Board have also elected four Honorary Members, with whom they expect to establish a valuable correspondence. These gentlemen are:—

1st. John Franklin Caruthers, A. B. President of the Franklin Society, Lexington, Virginia.

2. Professor Edward Graham, of Washington College, Lexington, Virginia.

3. Professor John Griscom, of New York, and

4. Samuel Parks, F. L. S. &c. of London.

An object of much importance, but to which your Board have as yet been unable to attend, is the establishment of the Library and Cabinet of Minerals, which, they have reason to believe,

will, as soon as commenced, meet with a great and rapid increase. The want of a suitable Hall, in which to deposit these collections, has hitherto prevented your Board from turning their attention to this subject, but the agreement which they have just concluded with the Carpenters' Company, will remove the only difficulty in their way.

Your Board have much satisfaction in informing you that they have contracted with that Company for the whole of the building known by the name of the "Carpenters' Hall," at the rate of five hundred dollars per annum. By renting the second story to the present tenants, the expense will be reduced to two hundred and twenty-five dollars, and it is believed that the rent will be reduced still lower by adopting the judicious system of letting out the hall on the lower floor at the times when the Institute will not require it.

The Board believe that a hall so central and so adequate for the various purposes of lecturing, holding the collections of the Institute, offering a suitable place for the meetings of the Board and of the Society at large, could not have been obtained on easier terms.

The Board have several other objects in contemplation, which, as soon as they are determined upon, shall be laid before the Institute.

The Board regret to have to inform you that a vacancy occurred in their numbers, occasioned by the death of their respected Chairman, *Robert Patterson, Esq.* Mathew Carey, one of the Board, was chosen Chairman, and Harvey Lewis, a member of the Institute, was elected to fill the vacant seat in the Board.

All which is respectfully submitted, by

M. CAREY, *Chairman.*

WILLIAM STRICKLAND, *Secretary.*

Philadelphia, October 21, 1824.

FOURTH QUARTERLY REPORT,

MADE TO THE INSTITUTE, AT A MEETING HELD JANUARY 20, 1825.

To the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, the Board of Managers offer their fourth Quarterly Report.

At this period which, by the provisions of our Constitution, is appointed for the annual renewal of the officers of the Institute, and when your Board are about to surrender to their constituents, the trust committed to them, it may not be inexpedient to extend our views beyond the mere transactions of the last three months, and to include in one Report an abstract of those objects, which have occupied the attention of your Board, during the whole of their term of office. This investigation, concise as it must necessarily be, will, we trust, confirm the position established in our former communications to the Institute, that the value and utility of this Society will but become more apparent as the Institution itself becomes more matured.

The Institute was organized on the 5th of February last, and the officers for the first year elected on the 16th of the same month. If we contemplate the objects which have been accomplished during the short period of eleven months, which has elapsed since the commencement of our operations; if we advert to the great, and almost unparalleled popularity which has attended it, and which has been evinced by a large list of subscribers, the greater part of whom will be found to be among the industrious part of the community; finally, if we consider the flourishing state of our finances, we will be justified in concluding, that our community was ripe for this great undertaking—that the benefits of the Institute have already been felt and acknowledged,—and that perseverance and industry on the part of the members, are alone requisite to enable us to realize the brilliant anticipations which we feel ourselves warranted in making of the future usefulness and prosperity of our Institu-

tion.—Yielding to others the palm of originating these useful associations, we may with complacency compare the progress which we have made during the period of our operations, with that of Societies founded in cities, which, in wealth, populousness and resources, are equal or superior to our own; whether, in our comparisons, we consider the exertions which have been made, and the objects which have been achieved, by the various mechanic Institutes of England and Scotland, or by our sister Society in New-York, we will obtain the pleasing conviction, that however much they may have done, we have every reason to be satisfied with our progress. There is, however, a source of gratification, which we may be permitted to enjoy, to the exclusion of some, if not of all similar Societies; and this arises from the knowledge, that whatever good we may have done, whatever objects we may have achieved, they have been obtained by our own unassisted efforts: we have not seen our treasury filled by the liberal munificence of one or more patrons; we have earned our own success, by our individual contributions; if this should give us cause to apprehend that all the beneficial objects of the Institute cannot be very speedily accomplished, it at least impresses us with a justifiable feeling of honest pride, at the contemplation of the good which we have been enabled to do; and with a patriotic resolution, not to shrink from the task, until all our objects shall have been attained.

Our Constitution, states the objects of the Institute to be, "the promotion and encouragement of Manufactures, and the Mechanic and useful Arts, by the establishment of popular lectures, on the sciences connected with them; by the formation of a Cabinet of Models and Minerals, and a Library; by offering premiums on all objects deemed worthy of encouragement; by examining all new inventions submitted to them, and by such other means as they may judge expedient."

In the following Report, we shall enquire how far each of these objects has been attained, and conclude by some general observations, upon the present state of the Institute, the objects which are now under the consideration of the Board, and which will of necessity require the immediate attention of our successors in office, the topics which one year's attention has sug-

gested to us, as likely to deserve the consideration of the Society, at a future period, and conclude by a few general observations upon the prospects which the Institute appears to us to present to its friends.

The board having organized itself, made rules for its own government, and obtained a charter of Incorporation from the General Assembly of this Commonwealth; the first subject, which engrossed its attention, was the establishment of popular lectures. Partly with a view to realize immediately the benefits of the Institution, and partly to enable the public to form a just conception of the objects of the Members, a series of lectures was announced for the summer season. As the shortness of the time for preparation did not allow your Board to make arrangements for permanent and connected lectures, they had to depend upon the spontaneous exertions of their Members, several of whom undertook to lecture occasionally, in such a manner, that the weekly lectures were continued for upwards of three months; by this means, the Institute became better known, its list of Members received considerable accessions, and the Managers found themselves enabled to prepare for the other objects which they had in view. A regular system of lectures has been adopted; four Professorships created, viz. on Natural Philosophy, on Chemistry and Mineralogy, as connected with the Arts and Manufactures, on Architecture, and on Mechanics; the last of these Chairs remains vacant, the others have been filled by the appointment of Dr. Patterson, and Messrs. Keating and Strickland, who have lectured this winter, in the following order—Dr. Patterson and Mr. Strickland, alternately every Monday, on Mechanics and Architecture, and Mr. Keating every Saturday on Chemistry. This regular system commenced on the 10th of November last. The Wednesday, was originally reserved for volunteer, and occasional lectures, on miscellaneous subjects, and has been hitherto occupied by the following gentlemen, viz. Mr. Espy has lectured twice upon the nature and objects of the Barometer. Dr. Godman, has delivered two lectures on Anatomy, as explaining the principles of motion, in the human frame, and on the circulation of the blood. Mr. Browne has lectured three evenings, on the law of patent rights, for new and useful in-

ventions and discoveries; and Dr. Griffith has delivered the three first of a series of Lectures, on the diseases incident to the labouring classes of the community. This system of instruction will be continued during the winter season.

In addition to the regular lectures from Dr. Patterson, Messrs. Strickland and Keating, the Board expect the continuation of Dr. Griffith's valuable lectures, and a few more from Members who have volunteered their services to this effect. Among these, the Board are happy to announce that they have the promise of a lecture on the important art of Pottery, from a gentleman practically conversant with this useful and interesting art. This lecture will, we trust, prove an inducement to other Members of our Institution, to offer the result of their experience in their respective arts. We must not be unmindful of the important benefits which will attend these practical lectures. We look to these as likely to complete and fill up the general sketch which the lecturers on Scientific subjects, will have but pencilled out. The Board acknowledge, that in addition to the lectures, to which they have alluded, they received offers from other persons, upon subjects which did not appear to them so closely connected with the purposes of the Institute as to admit of their being accepted. These they therefore respectfully declined.

The attendance upon the lectures has been very general, and sufficiently so to render in some instances the large Hall, in which they are delivered, inconveniently crowded. Among those who are regular attendants, your Board have with pleasure observed many young individuals, who are either sons or apprentices of Members. The books of the Treasurer will show that exclusive of thirty-nine who attend the Drawing School, and who are therefore entitled to admission to the Lectures, fifty-four Lecture Tickets, for the use of Junior Students, have been sold during the present year. There is every reason to believe that this number will be considerably increased next winter. The facility, which the Institute at present affords to parents and masters, loudly calls upon them to improve this opportunity of impressing, at an early age, upon the minds of their sons and apprentices, a taste for study, and correct doctrines upon those sciences which so materially affect the arts. There can be no doubt that the small sum of one

dollar, (the payment of which entitles the son or apprentice of a Member to an attendance upon all the lectures delivered in this Institution,) would be soon compensated to the master himself, by the improvement, both moral and intellectual, which it would produce in the mind of these youths. With a view to afford them every opportunity of profiting by the Lectures, seats in advance of the class have been specially reserved for their use.

Connected with this subject is the Drawing School, lately established by the Board, and to which they would for a few moments solicit your attention. The great importance of the art of Drawing to Mechanics and Artizans of all classes, is so generally felt, and has been so universally acknowledged, that your Board do not conceive it necessary to insist upon it here. The plan which they have adopted is the only one which has suggested itself to them as practicable, and in the execution of it they have met with much assistance from the liberal and zealous co-operation of Mr. Haviland, under whose direction the School has been placed. He is assisted in the tuition by Mr. Bridport. The Drawing School, though of very recent creation, includes already about fifty pupils, and is daily increasing. It is open two evenings in the week, Tuesdays and Fridays. The low price of the ticket, (which is but five dollars for the season) and especially the high reputation of the instructers, will, it is confidently believed, make this a very flourishing and useful branch of the Institution. Your Board have seen with pleasure that it includes not only pupils from the city, but also several who reside within a few miles of Philadelphia in this County, and even some from the adjoining Counties. The zeal and assiduity manifested by these pupils give great promise of future excellence.

The next object to which the attention of the Board was directed was the establishment of a Cabinet of Models. The very useful and elegant Architectural Models which have been executed by order of the Board, and which have assisted Mr. Strickland in his demonstrations, attest the importance which the Board have attached to this part of their duties. Several of the Mechanical Models have already been executed, and contracts for

the preparation of the remainder have been entered into. The sum of $300, expended during this year, for this object, and which does not include the Models now making, will, we trust, be considered as large, considering our means, and will prove the foundation of a Cabinet of Models whose usefulness and extent will be commensurate with those of the Institute. In the construction of these, your Board have considered that it was better to obtain, from the first, such models as would always prove useful and sufficiently large, instead of procuring some at an inferior expense, but whose diminutive size or imperfect execution, would have made them merely of a temporary character, and rendered their renewal indispensable at no distant period of time.

The Institute was, as is well known, for a few months without a permanent residence; and while your Board were anxiously seeking for one, they were prevented by the want of a suitable place of deposite, from bestowing much attention upon the formation of a Mineralogical Collection and Library. Since the lease of the Hall, your Board have adopted a uniform plan of Mineral and Book Cases, several of which have already been completed. Their construction has been made with as much economy as was consistent with the preservation of the specimens or books which may be deposited in them. The Mineral Cases are eight feet high, by 5 feet 4 inches wide; they are divided in their height by six shelves, each of which consists of three ledges, arranged in the form of right angled steps, and upon which the Minerals will be arranged in a manner which will unite all the advantages without any of the inconveniences of an inclined shelf. The Minerals will be protected from the dust by close sashes, which, instead of sliding in a horizontal groove, as is usually the case, will admit of being raised and dropped by means of balancing weights. The cases are at present ready for the reception of the Minerals which, from the flattering promises that have been made, will, it is believed, soon become both numerous and interesting. The plan which your Board conceive to be the most advantageous, is the distribution of the Minerals in a Geographical order, according to Counties for the Minerals of Pennsylvania, according to States for those from

other parts of the Union, and according to Countries for all foreign Minerals. It is expected that after a while most of the Counties in Pennsylvania will require one or more cases. The Board are indebted to the liberality of your President for the first of these cases, appropriated at his request to the reception of the Minerals from Delaware County. Following the plan to which we have just alluded, it will be easy for any observer to catch at a single glance a view of all the productions of any part of our highly favoured State. It is proposed whenever the collection becomes sufficiently large to admit of a division, to select from it the finest and best characterized specimens, which will be arranged on horizontal tables, in a scientific manner, for the use of those who wish to examine a collection disposed in the best order for study.

The Library will also, it is believed, soon increase, and become valuable. The want of a proper place of deposite has hitherto checked the donations of books, and has required that those heretofore presented should be dispersed for safe-keeping, into the hands of the Members of the Committee. The objects which the Board considered as more imperatively calling for appropriations, being numerous, have induced your Board to devote to the Library, during the last year, no other funds but such as were required for book cases, and to defray the subscription to a few of the most valuable practical Journals in Europe. It is expected, however, that with some exertions on the part of the Committee, to whom the subject may be referred by our successors in office, and with a moderate appropriation from the funds of the Institute, a foundation can be laid for an extensive and valuable Library, which we think ought to be immediately divided into two sections, and the proper books assigned to each. The first section would constitute a Library of reference, to consist of such Books, as from their scarceness, value, or extent, ought not to be lent out, except on special occasions, and, in this case, only under very strict regulations. To this class might be added those works which, being considered as text books in Science, ought necessarily to be found in a Library of Reference. The second section or department, might include books intended for circulation among the members, their sons,

and apprentices. The Apprentices' Library being at present situated under the same roof, and its privileges being enjoyed by a number of our Members, it would be well to attempt as much as possible to obtain for our Circulating Library such books as they have not, and to avoid the unnecessary collection of duplicate works in Institutions which, having the same object in view, may, by a judicious consultation, become doubly valuable.

At as early a period of their administration as was consistent with their other duties, your Board made preparations for the holding of Exhibitions in this City. Considering that great benefits resulted from these exhibitions elsewhere, they advertised their intention to hold one on the 18th of October, and invited all persons interested in the success or promotion of American manufactures to contribute to it. The exhibition, which was held at the stipulated time, so far exceeded their expectations, gave such general satisfaction, was productive of such substantial benefits to the Institute, by an immense accession of subscribers, was so generally visited by the members of the Institute, and by the public at large, arousing such feelings of conscious pride in the bosoms of every friend to our industry, that your Board deem it unnecessary to dwell upon its merits or its usefulness. The short time allowed to our manufacturers for preparation, prevented many at a distance from contributing to it; but in some instances, articles from the Sister States were received which had been prepared expressly for our purposes. The extensive promises of assistance which the Board have received for the next exhibition, induce them to hope that in October next, our Institution will again become signalized by its usefulness.

To excite a higher emulation among the mechanics and manufacturers, a list of premiums, to be awarded at the exhibition, was prepared and circulated; of these your board has had the pleasure of awarding fourteen; a list of which, as well as of all the objects exhibited, will be found in the Reports made to the Board by their Committee of Premiums and Exhibitions, copies of which are hereto annexed. The time required to prepare a die, for the striking of medals, did not allow the Board to present the medals at the time they were awarded: the engage-

ments of the artist to whom this object was entrusted, have hitherto prevented him from accomplishing it. But the Board have great pleasure in informing you that the contractor, Mr. Wm. Kneass, die sinker to the United States mint, and an artist of acknowledged merit, has pledged himself to execute them with as little delay as possible. In the mean while, the successful candidates have received certificates signed by the President and Secretary of the Institute, acknowledging their claim to the medals.

The board have prepared a list of premiums to be awarded at the second annual Exhibition, to be held on the 6th, 7th, and 8th of October next, a copy whereof is hereto annexed. The list will be found far more extensive than the last; it includes many arts both chemical and mechanical.

Among the subjects upon which the board have thought it necessary to lay most stress, are the manufactories of iron and steel in all their branches, of woollens, cottons, &c. The application of coal, whether of the bituminous kind or the anthracite, is likewise considered as entitled to the greatest attention. Wood is daily becoming scarcer; its consumption has, by the great increase in our manufactures, been scarcely checked by the modern use of coal in our city and the adjoining counties. Your Board have therefore deemed it their duty to call the attention of our manufacturers to this point. They have been credibly informed that the manufacture of iron, which may be considered as one of the staple products of Pennsylvania, cannot, under existing circumstances, be carried to a much greater extent than it is at present, from the increasing scarcity and price of wood. If coal be not resorted to, the quantity of iron manufactured a few years hence, far from keeping pace with the general increase in our manufactures, will be completely checked by the want of fuel.

That our castings are not so good as the English and Prussian, is a point generally admitted, and which can probably be attributed to no other cause than to the absolute neglect or refusal on the part of our iron masters to work the ore best adapted for this purpose, which is the argillaceous carbonate of iron, (clay iron stone of mineralogists;) this is the ore which is chiefly used in

England and Silesia; it abounds in various parts of Pennsylvania; with this view, premium No. 58 has been introduced.

It will be observed that in a number of the premiums proposed, the Board have decided to take the price into consideration, and to require that assurance will be given that a certain quantity of the articles will be furnished at a reasonable price: this is essential in all articles in which cheapness is a requisite. While the Board are desirous that the manufacturers should devote as much time, industry and skill as possible, to the preparation of the finest broad cloths, intended to exhibit the perfection of the art in this country, they are convinced that all this labour would be unprofitably applied to the preparation of those objects which are destined for the use of the less affluent members of society. The merit, therefore, of these last manufactures must, in a great measure, depend upon the cheapness at which they can be afforded; and to prevent the offering of a price lower than that at which the manufacturer would be willing and able to dispose of them, the condition has been introduced binding the manufacturer to furnish a reasonable quantity at the stipulated price, should any person apply for it.

Another object which your Board have conceived to be highly important, as connected with the exhibitions, was to take advantage of the influence, which the Institute may have acquired, or of the popularity which usually attends exhibitions, to induce the manufacturers to correct those defects that have probably originated in carelessness, but that appear at present to be sanctioned by usage, and supported by prejudice; among these is the practice of leaving a fag end, or portion of crude metal at the extremity of bars of iron; this is evidently unnecessary, and improper; it is an unjustifiable tax upon the consumers; with this view, a provision has been introduced in premium No. 3, requiring that all bars of iron intended for competition, should be free from this blemish, and the Board would suggest to you the propriety of extending this correction of abuses, to other branches of industry.

Our community being partly commercial, and partly manufacturing, is interested in the success of all those arts, which are connected with naval architecture. And hence, the Board has

been induced to propose the several premiums, connected with that subject, and which, it is hoped, will excite the attention of our Ship-wrights.

One of the most important objects, and which is imperiously called for, by the present state of the country, is undoubtedly, the publication of a weekly Journal, containing that practical information, which, at the same time that it is valuable to all Members of the community, is indispensable to the mechanic and manufacturing citizens. In their first quarterly Report, the Board acknowledged the importance of this subject, but expressed their apprehensions, lest the establishment of such a Journal would at that time be premature; and invited you to lend your support to the Journal, about to be published under the direction of one of the officers of the New York Mechanic and Scientific Institution. They regret that the publication of that Journal has been deferred by the difficulty which the Editor has found in securing himself against the chance of pecuniary losses; this delay has induced your Board to make some preparations for the establishment of a Journal of this sort in our own city. They have every reason to believe, that this work, if undertaken by a competent person, with the assistance and sanction of a committee of the Institute, and supported by the subscriptions of the Members, might commense with a reasonable prospect of success. With a view to pave the way for this undertaking, a Committee has been appointed, to make selections from foreign Journals, and publish them every week, in one or more of the city papers. This plan has just commenced, and will be continued until some more effectual means shall have been matured. Within a few days, your Board have been informed, that the New York Journal would soon make its appearance, and, that in order to obtain the support of the Institute, the work would be offered to our Members on more liberal terms, than to the generality of subscribers. Assured of the talents, industry and opportunities which the Editor will have, to render his Journal useful and interesting, the Board again respectfully recommend it to your notice. They are satisfied, that not only one, but many Journals of this nature, could be advantageously published in the United States, but that it is better to avoid at

first a competition, which, by injuring the prospects of both Journals, would affect the interests of the cause which we all have at heart.

Preferring the general benefit of the Arts to the slight and selfish gratification, which might arise from a precedence in such an undertaking, and opposed to every thing which might appear to savour of local prejudices, unworthy of such an Institution as ours, your Board would recommend the withholding for the present, the plan of publishing a Journal under the sanction of this Institution, until the increased taste and demand for such a publication will justify its adoption.

Your Board regret that they have failed in their efforts to obtain by an amicable negociation, with the superintendent of the Patent office, in the city of Washington, the acknowledgment of what they deem their unquestionable right, to be permitted to take copies of the specifications of all new patents. Instead of the assistance and facilities which they had anticipated, they with pain acknowledge, that their application has been denied. They have long waited, in hopes of a more favourable issue, but have at last determined to seek redress from the proper authorities. This delay has prevented them from giving the desired activity to one of the most important branches of the general plan of usefulness of the Institute, viz. the examination of all new machines, or inventions; yet they with pleasure state, that eight new inventions have been submitted to them, among which, after reference to special committees, they are induced to recommend Mr. Shaw's detonating lock for guns, &c. Mr. Stancliffe's spherical cock; Mr. Goodwin's new lock, suitable for store or house doors, and uniting security and durability; Mr. Robert Leal's improvement upon tide-mills, and Mr. Rouse's spring-locks. Your Board regret, that more has not been accomplished in this department, but it is pleasing to see the work commenced. By letting the public know that the Institute will examine and Report upon all inventions submitted to them, much good may be achieved in this manner. The object of the Institute is by no means to erect itself into an umpire, under an impression of its infallibility, but to communicate to such as may apply for it, the opinions derived from the science, or experience of its own

members; regard being had in the appointment of all special Committees, to avoid the nomination of individuals whose prejudices or partiality might affect their decisions in certain cases.

Your Board acknowledge with pleasure, that the Institute has many very warm friends who have, by offers of services or of work in their respective departments, or by contributions to your Library and Cabinet, evinced the sincerity of their zeal, and attested the high estimation in which the public now holds your Institution. There are many, whose liberality deserves special notice, but whose assistance your Board are at present precluded from recording, hoping that the increase of your Library and Cabinet will soon require a description and catalogue, in which these will all be recorded. Your Board cannot, however, at present omit mentioning the liberal offers of Dr. Godman, who, in addition to the lectures which he has delivered to the Institute, has sent three tickets to his private lectures, for the use of three of the junior students of the Institute, and who, moreover, has politely extended the privilege of attendance at all his demonstrations on Anatomy, to the professors and students of your Drawing School.

Convinced that the title of Honorary Member of this Institution ought to be restricted, and granted to such only as are distinguished by their success in the useful Arts, and in the sciences, or by their distinguished zeal for their promotion, your Board have not extended this privilege beyond the four Members whose names were reported to you in the third quarterly Report.

The Treasurer's Report, hereto annexed, will exhibit the amount of receipts and expenditures during the year ending January 10, 1825, and is a flattering statement of the situation of the finances of the Institution. By a judicious system of economy, the receipts of the present year have not only sufficed for all the necessary expenditures, but have even afforded a surplus fund of $1093,46.

In all necessary expenditures the Board believe however that they will not be liable to the charge of parsimony: their appropriations to the lecture expenses, to models, premiums, &c. will, it is hoped, be found to bear a just relation to the prosperity of

the Institute. From the surplus monies $510,52 have been laid as the foundation of a permament fund, which, accumulating by constant additions of capital and interest, will, after a while, afford to the Institute the means of carrying into execution the more expensive parts of our plan. The difficulty of determining without one year's experience the amount of the unavoidable expenses of the Society, have prevented the Board from deciding what proportion of the receipts ought to be annually appropriated to this fund; but they have already resolved to devote to it all monies arising out of the sale of lecture tickets to junior students, exclusive of the drawing school class. It will be recollected that the expense of fitting up a room for lectures, and of creating the commencement of a cabinet of models, have required outfits which will not again be called for, but that the expenses of the ensuing year will be increased by the cost of the dies, the higher rent which we now pay, the expenses incident upon a larger exhibition, the award of more premiums, the salaries of professors, the procuring of some chemical apparatus, and by sundry other items of expense which cannot at present be enumerated. All these considerations will render it a matter of great moment for our successors to make a proper appropriation to a permanent fund, the importance of which will be admitted by all on reflecting that the Hall in which we now deliver our lectures, though well adapted to our present condition and numbers, will prove too small if the increase of members should continue as we have a right to expect it will, and if the members should more extensively apply for the benefit of introducing the younger individuals of their families to the lectures. The collections of the Institute will likewise probably soon require a separate apartment. We may, therefore, without incurring the charge of indulging in idle speculations, look to the period as not far distant when our present Hall will be too small for our wants; we shall then be compelled to seek for a more spacious building. Your Board know of none in the city which they could obtain, and which would be suited to their purposes. The erection of one will then become indispensable. A prudent foresight most imperatively calls upon us to lay by annually as

much as we can spare in order to meet that important expenditure, whenever a further delay shall have become unavoidable.

There are other objects which likewise require more capital than that which we can now command; of these none deserves more serious consideration than the establishment of an experimental and practical school, consisting of a workshop and laboratory, to which the sons and apprentices of members may repair for practical instruction in the sciences connected with their professions. One of the principal objects of such a school, would also be to promote the improvement of the arts, by testing by a series of experiments, the merit of every new process or invention, and by analyzing, free of charge, all the products that may be sent to it from different parts of the state. That such an establishment will require a considerable capital, and be attended with much expense, cannot be doubted, but while we witness the great progress which our Institution has already made, we cannot permit ourselves to assign a limit to the importance which it may at a future day attain.

At any rate while we may be permitted to rejoice at the share of good which the Institute has already effected, let us not be unmindful that it bears no proportion to the good which still remains undone, and that while such a field is open before us, it behoves us to be vigilant and indefatigable.

The list of members hereto annexed, is believed to be complete up to the 18th of this month, it includes five hundred and sixty names.* Four of our members, whose names were on the first printed list, have died since its publication. Among them was the worthy individual who headed our list of managers, and who first filled the station of chairman of the board of officers. A few of those persons who had inscribed themselves as members, have declined to pay their dues, and desired that their names should be omitted from the list, they are therefore not included in the above number. While upon this subject we may remind the members that our Constitution provides that they shall sign their names to that instrument. A

* Since the above Report was read, sixty-seven new members have been elected, and their names are included in this list.

book has been prepared for that purpose, in which all are requested to inscribe themselves.

In conclusion, this Board beg leave to tender to the members of the Institute individually their warm thanks for the kind and liberal support which they have received at their hands during the closing year, and without which, it would have been impossible for the Board to have prosecuted their labours. With this tribute of gratitude, and with the expression of their best wishes for the prosperity of the Franklin Institute, the officers and managers, elected for the first year, now close their official duties.

On behalf of the Board,

M. CAREY, *Chairman.*

WILLIAM STRICKLAND, *Secretary.*

Philadelphia, January 18, 1825.

Report of the Exhibition of 1824.

PART I.

REPORT OF THE COMMITTEE ON PREMIUMS AND EXHIBITIONS.

To the Board of Managers of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, the Committee on Premiums and Exhibitions beg leave to Report—

That an exhibition of the products of domestic industry was held, pursuant to the plan adopted by the Board, on the 18th, 19th and 20th October, during which time a great number of articles were exhibited, most of which were commendable for the excellence of their workmanship, and some for the ingenuity displayed in their manufacture.

Of the thirty premiums offered by the Institute, nine only were claimed, by one or more competitors, as follows:

1st. *On Blister Steel.*—Five competitors offered specimens of their manufacture. The quality of all the samples was considered good; Mr. James Rowland, jun'rs, specimen having been declared by the judges to be the best, the committee recommend that the SILVER MEDAL of the Institute should be awarded to him.

2. *Bar Iron.*—Specimens were exhibited by two competitors for the premium on this article; they have been examined by a committee appointed for that purpose, who Report them to be of excellent quality, but as one of the conditions annexed to the premium was, that the Iron must be "equal to any imported, for converting into steel," these specimens have been handed to Mr. Rowland, in order that their quality in this respect should be tested;—as soon as his report shall have been received, the result will be communicated to the Board; until then your Committee suggest that the premium be withheld, and that an honorary mention be awarded to Messrs. *William Coleman & Co.* of Lancaster, and to Mr. *Irvine* of Chester county, for those specimens of Bar Iron.

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3. *Japanned Goods.*—Two specimens were exhibited for premium; of these, Messrs. Blackmore and Jones presented the best, and as the quality of this was very good, the Committee have no hesitation in suggesting that they are entitled to the SILVER MEDAL.

4. *Broadcloths.*—The quality of cloths exhibited was in every respect commendable; two of the pieces, having by far surpassed all others, have been judged deserving of particular notice. The very competent judges who examined them have reported to your Committee, that the two pieces of blue cloth exhibited by Messrs. Sykes & Co. near Baltimore, and Messrs. Wells & Co. of Steubenville, Ohio, were remarkable for the softness and firmness of their texture, the richness of their colour, the beauty of their finish, and the moderate prices at which they were offered. The piece from the manufactory of Messrs. Sykes & Co. is made of wool, a little superior in quality, and its colour is a little better than that of Messrs. Wells & Co. but the latter exhibits more skill in dressing, and has also the merit of being made of American wool, while the other was made of Saxony wool. The merit of those two pieces being so equally balanced, the judges were unwilling to assign a preference to either, and considering both equal, if not superior, to any American cloth that has ever come under their notice, and nearly, if not quite, equal to the best imported fabrics, they have suggested that both were entitled to the highest compliment which the Institute could give them: your Committee therefore recommend that the SILVER MEDAL should be awarded to each of these Competitors.

5. *Satinetts.*—The specimens exhibited were very good, but not of a quality to require that the premium should be awarded to any of them.

6. The samples of *Negro Cloth* were deemed good; and that from the Pennsylvania Institution for the Deaf and Dumb, being the best, is in the opinion of your Committee deserving of the premium offered upon this article, which is the SILVER MEDAL.

7. Of the specimens of *Cabinet-Ware* exhibited, only one was offered with a view to competition, which being a very superior piece of workmanship of its kind, is, in the opinion of your Committee, entitled to a premium. They therefore suggest that the

SILVER MEDAL be awarded to Mr. John Stiles, for the very fine Writing Desk exhibited by him.

8 and 9. The Straw and Grass Bonnets exhibited deserve to be particularly mentioned; all were of good quality, and very creditable to our manufactures. The Committee who examined them "have, in forming their opinion, taken into consideration the fineness of the straw employed, the neatness of the plait, the regularity of the manufacture, and then, the effect of all these properties, in producing an article that could compete with the fine imported bonnets, in which good colour is a material point."

They have reported to your Committee that they had found the *grass hat* in imitation of Leghorn, made by the pupils of the Pennsylvania Institution for the Deaf and Dumb, to combine the greatest number of the properties that characterize the Leghorn *bonnets*. A split *straw hat* by the children of the *Fellenberg School* appeared the best of its kind, and was judged to possess most of the properties requisite to a fine bonnet. Your Committee would therefore recommend to you to award the SILVER MEDAL to each of these Institutions.

In pursuance of the plan adopted, to award premiums to such objects, not enumerated in the printed circulars, as might appear worthy of encouragement, your Committee beg leave to represent to you, that a great number of articles were exhibited which had not been anticipated by the Board; among which were several Models of Machines and other objects, many of which evinced much mechanical ingenuity, and a few of them deserved the highest praise. Competent judges were appointed to examine them all, but owing to the crowded state of the room, and the lateness of the time when some of the articles were offered, it was impossible for them to make up their decision upon the merits of all, in time for this Report. Upon some of them they have expressed their opinion, and others are still under consideration. The following are recommended to your Committee as deserving particular notice:—

1. A very ingenious machine invented by Thomas F. Sarchett, *Stove maker*, for *cutting and piercing iron plates*, for *stove pipes*; three of which are prepared by it at a single operation, by the force of one man, in less than a minute. Your Commit-

tee adopt without hesitation the suggestion of the Judges, and recommend that the SILVER MEDAL be awarded to the inventor of this useful machine.

2. Several specimens of *Domestic Carpeting* were exhibited, all of which were judged to be of very good workmanship, and one among them, made in this city, was considered to be a very superior article of its kind; it is well woven, and a tasteful pattern. This being a very useful article, and no *ingrain carpeting* having been exhibited to claim the twenty-fourth premium, your Committee beg leave to suggest that the SILVER MEDAL be awarded to Joseph Swartz for the best piece of *domestic carpeting*.

3. A beautiful *maroon work box*, manufactured by William Tait of this city, and exhibited by him, attracted much notice, and appeared to the Committee appointed to examine it, to be deserving of much praise for the ingenuity and taste displayed in its design, and the neatness of its execution, rivalling the best specimens of imported articles of similar kind; and although your Committee do not conceive fancy articles of so much importance as objects of utility, they form an important branch of *domestic industry*, and where they are distinguished for excellence of workmanship, they ought to receive the encouragement of the Institute. Your Committee therefore recommend that the BRONZE MEDAL be awarded to Mr. Tait for his elegant *work box*.

4. To George Catlin, for a *bassoon* exhibited by him which has many improvements not before introduced in this instrument, and the tone and finish of which are excellent, your Committee propose that the BRONZE MEDAL be awarded.

Your Committee further beg leave to recommend that honorary mention be awarded to the following persons:

1st. To John Struthers, for a very elegant *marble mantlepiece*, in which Egyptian and Irish marbles are tastefully connected with American marble.

2d. To Stephen P. Morris for a very fine *coal grate*, manufactured and exhibited by him.

3d. To Ebenezer Mustin for the tasteful painting upon a *Japanned tea tray*; had the quality of the japanning been equal to

the beauty of the painting, this artist would have been entitled to the medal.

4th. To Mr. Schneitman, Lapidary, for very excellent *Lenses* and *Spectacle glasses*, ground by him. This artist has just arrived in the Country; and it is hoped, that he will find encouragement in his business; as it is a branch of industry deserving the patronage of the Institute.

5th. To John & Thomas Loud, of this city, for a very excellent *Piano Forte* exhibited by them; and 6th. To William Geib, of New York, for one of his *Piano Fortes* exhibited by George Willig. As neither of these instruments was intended for competition, the Committee have not recommended either for premium, but they hope that those able artists will send specimens for the next exhibition.

7th. To M. W. Baldwin for an engraved Copper Roller, for printing Calico, which for the neatness of its execution deserves much praise.

8th. To Messrs. Bakewell & Co. of *Pittsburg*, and to the *New England Glass Company of Boston*, for good specimens of their *Cut Glass Ware*, deposited by several gentlemen of this city. It is hoped that the manufacturers of this elegant article will come forward themselves and present specimens at our next exhibition, worthy of the high reputation which they have acquired.

9th. To William Rush for his Bust of General La Fayette: and 10th. To *Luigi Persico* for one of the same subject, both of which were pronounced by competent judges to be excellent in their kind. As neither of the Artists was desirous that a competition should be established between them, your Committee have judged it unnecessary to enter into an examination of their comparative merits.

11th. To Messrs. Phillips & Co. of *Phillipsburg*, Pennsylvania, for samples of their *Screws* made at one operation, by a *machine* of *American invention*, from Iron of their own manufacture. These screws are superior to the best imported; and it is hoped that they will soon be brought into general use.

12th. To Joseph Saxton for a *Clock* made by him, and exhibited by Philip Garrett. This Clock is a very beautiful speci-

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men of workmanship, and the *Escapement* is upon an entirely new principle; the Committee appointed to examine it, have it still under consideration. As soon as their report is received it shall be communicated to the Board.

In addition to the above, many good articles were exhibited, which will all be particularly noticed in the detailed Report which your Committee are preparing, and will offer to the Board as soon as practicable. In that Report will be included a complete list of all the articles exhibited, together with the names of the gentlemen who acted as judges of the Exhibition. The present communication is almost entirely made up of observations contained in their Reports. Your Committee beg leave to request that the thanks of the Board be voted to those gentlemen for their active exertions in behalf of the Institute, and for the impartial manner in which they discharged their duty. Great praise is also due to the gentlemen who volunteered their services on the Committee of Arrangement—their duties were rendered very arduous by the lateness at which many of the articles were sent—They therefore deserve the thanks of the Board.

All which is respectfully submitted by

JAMES RONALDSON,
THOMAS FLETCHER,
ADAM RAMAGE,
WILLIAM H. KEATING,
SAMUEL V. MERRICK,
Committee.

Philadelphia. October 26. 1824.

FINAL REPORT OF THE COMMITTEE ON PREMIUMS AND EXHIBITIONS.

To the Board of Managers of the Franklin Institute, the Committee on Premiums and Exhibitions beg leave to present their final Report:

Your committee, having executed the duties assigned them, annex herewith a list of the committees to whom were referred the various articles presented at the exhibition of the Franklin Institute, held on the 18th, 19th and 20th of October, together with an account of the articles deposited and their relative merit, according to the information contained in the reports of the respective committees. The Board have reason to congratulate themselves and the Institute upon the success attending their first experiment; the good effects of which are manifest. It is, however, to be regretted, that while an opportunity so favorable is offered for making the artisan and the consumer acquainted with each other, so few of our mechanics should have availed themselves of it, in a city which stands pre-eminent in the mechanic arts; and it is respectfully suggested that more efficient measures should be taken to acquaint the mechanics and manufacturers, that a similar opportunity will be offered them during the ensuing year. Your committee are well aware that errors have been committed in their first essay, and must beg the indulgence of the public, feeling assured that the experience of their exhibition will enable the Institute better to conduct them hereafter.

Your committee beg leave to call the attention of the Board to a clock invented by Joseph Saxton, and exhibited by Philip Garrett. This clock was still under advisement when the first report of this committee was presented; the committee appointed by them to examine it not having sufficient information relative to its novelty or utility; since which, they have reported that the 'scapement is new, and that it has a new kind of compensating pendulum, and in their opinion, merits the most particular approbation of the Board. The friction of this ingenious clock is so much diminished as to require no oil on its pallets. Your committee, therefore, recommend that the SILVER

MEDAL of the Institute be awarded to JOSEPH SAXTON for his *newly invented clock.*

All which is respectfully presented by

JAMES RONALDSON,
THOMAS FLETCHER,
ADAM RAMAGE,
WM. H. KEATING,
SAMUEL V. MERRICK,

Committee on Premiums and Exhibitions.

At a meeting of the Board of Managers of the Franklin Institute, held November 4, 1824,

Resolved, That the two reports of the committee on premiums and exhibitions be adopted and published.

M. CAREY, *Chairman.*

HENRY HORN, *Secretary P. T.*

List of committees appointed by the Board of Managers of the Franklin Institute to decide on all articles exhibited:

1. Committee of Arrangement—Joseph Watson, (Mayor,) William P. Dewees, M. D., George W. Smith, John Haviland, William S. Warder, Robert E. Griffith, M. D., Ashbel G. Ralston.

2. Committee on iron and steel—Stephen P. Morris, John Agnew, Rufus Tyler, Joseph H. Schreiner, Prosper Martin.

3. Committee on copper, brass, &c.—Samuel V. Merrick, John D. Eisenhut, John Curtis.

4. Committee on chemicals—Robert Hare, John Harrison, John P. Wetherill.

5. Committee on cotton yarns—M. D. Lewis, William Christie, Joseph Siddal.

6. Committee on woollen goods—James M'Alpin, Moses Brown, C. C. Watson, Jr.

7. Committee on leather—Samuel R. Wood, George Robinson, George R. Brooks.

8. Committee on earthenware—James Ronaldson, William Shufflebottom, Abraham Miller.

9. Committee on glass—John M'Allister, John Moss, Robert A. Caldcleugh, Sidney Gardiner.

10. Committee on cabinet ware—John Haviland, Joseph B. Barry, Charles H. White.

11. Committee on mechanics—Robert M. Patterson, Samuel Wetherill, Frederick Graff, Benjamin B. Stancliffe, Isaiah Lukens, John M. Brewer.

12. Committee on straw bonnets—James Ronaldson, Reuben Haines, Alexander H. Clarke.

13. Committee on stationary and fancy articles—Peter A. Browne, Robert A. Caldcleugh, Sheldon Potter, John Rhea.

14. Committee on fine arts—Thomas Sully, William Strickland, Rembrandt Peale.

15. Committee on musical instruments—Robert M. Patterson. George E. Blake, George Schetky.

17. Committee on agricultural implements—John Hare Powel, Stephen Duncan, Reuben Haines.

18. Committee on paints and colors—Thomas Sully, Isaac Myers, William Heyl.

Notice of the various articles of manufactures exhibited to the public, at the exhibition of the Franklin Institute in October, 1824.

I. ARTICLES OF IRON OR STEEL.

1. Three parcels of blister steel were offered for competition: one from James Rowland, jr. one from Mark Richards, and one from Washington Jackson.

The quality of the steel was tried by the committee, and found

to be better adapted for springs than edge tools, requiring a high temper. It bore a good heat, worked well under the hammer, but when made into chissels appeared rather inferior to the best English blister steel. That submitted by James Rowland, jr. was judged to approach nearer the quality of English steel than the other samples, and to him the premium was awarded. The quality of the samples exhibited, and the known perfection to which this manufacture has arrived, give us reason to believe that samples will be produced at the next exhibition that will rival any that can be imported.

2. Two samples of bar iron were presented; one from Mark Richards, (Irvine's of Chester county;) one from Washington Jackson, (William Coleman's of Lancaster.)

Both these parcels were of very superior quality: as the premium for iron was offered on that best adapted for steel, the committee was unable to decide which was the most deserving. A bar of each was sent to James Rowland's steel furnace to be converted. As soon as the result is known, it shall be reported.

3 and 4. A cast iron garden chain well made, and remarkable for having a cast swivel very well executed, was deposited by Samuel Richards; also, from the same gentleman, a cast iron pipe 1.3-8 inch bore, which reflected much credit on the manufacturer.

The premium was offered for pipes of one inch bore, to be used as a substitute for lead pipes for hydrants; it is hoped that specimens of that size will be offered next year.

5. Two specimens of Japanned ware were exhibited: One from Blackmore and Jones, a clock dial, and several bread and tea trays; the other from Ebenezer Mustin, a waiter.

All were reported to be of excellent workmanship, and tastefully designed, especially the latter, though the specimens from Blackmore and Jones were of superior workmanship; to them the premium was awarded. The specimens, when compared with those imported of the same price, were found far superior.

6. Two printer's composing sticks were exhibited by Adam Ramage, and were judged good specimens of filing.

7. A pair of improved tailor's shears, by W. Davis.

8. A new improved Franklin gridiron, deposited by S. Harvey and Sons.

9. A sample of small wood screws, made by Messrs. Phillips & Co., of Phillipsburgh, deposited by R. E. Griffith. The screws are reported to your committee to be of superior quality to those imported; the heads are of a better finish and shape; the thread, deeper, smoother, and more regular. This is an infant manufacture, and reflects much credit on the enterprise of the owners. An honorary mention was awarded.

II. ARTICLES OF COPPER AND BRASS.

1. A set of brass shovels and tongs, and poker, by John Curtis. Well made.

2. A set of book-binders tools, by Mason and Baldwin.

3. An engraved copper Cylinder for printing calicoes, tasteful, and well executed, by Mason and Baldwin. Calico now forms a valuable branch of American manufacture; and the committee are well satisfied from the specimen before them, that the making and engraving of cylinders has arrived to such perfection in this country, as to overcome one great obstacle, and enable the American calico printer successfully to compete with the foreigner. The cylinder was made by S. V. Merrick and Co. and honorary mention was awarded to Mr. W. Baldwin.

III. CHEMICALS.

1. Meer's Crystallised Tin. The committee made no remarks, as they were not acquainted with the process, and as the execution of the samples did not appear unusual.

2. The imitations of inlaying in wood, by Mr. Meer, appear to deserve encouragement, as tending to supersede an expensive species of decoration by a cheap process; but in the specimen presented, the lines between the different colors are less agreeable to the eye than those of real inlaid work.

3. The razor strap and hone of Mr. Meer do honor to his ingenuity and skill. The committee, however, cannot decide between them and other instruments for the same purpose, without further experiment.

4. The workmanship of the sword blade by Mr. Meer is very fine.

5. The sheet iron stove by the ingenious and enterprising Mr. Gleason appeared to your committee sufficiently elegant in form and neat in workmanship. The gloss produced by a perishable japan, more pleasing to the eye than agreeable to the smell, ought to be subtracted in forming a fair estimate of the appearance; and in estimating its usefulness, the outer casing of iron is objected to, as obstructing the radiation of heat.

6. The Lehigh coal grate by Mr. Morris is obviously elegant in the workmanship. It is, however, liable to an objection analogous to that which has been made to Mr. Gleason's stove. The canopy over the top must obstruct the radiation, and bright brass has this tendency in a great degree.

7. The stoves by Mr. Miller have been found so useful by many who have used them, that it is unnecessary for the committee to recommend them to notice.

8. The transparent and other soaps exhibited by Beck and Stewart were equal to any from abroad.

9. The cold pressed castor oil had the negative excellence of wanting taste and smell in a high degree.

IV. MACHINES, &c.

1. Machine for making stove pipe by John F. Sarchet.

This useful and ingenious instrument is intended for the purpose of cutting and piercing iron plates for stove pipe, three of which are prepared by it at a single operation, by the force of one man, in less than a minute. The cutting is prepared by a kind of circular shears of cast steel, which have been used for a year without requiring to be sharpened. The pincers, which operate at the same time with the shears, are arranged upon cylinders in such a manner, that the lines of holes are not parallel, but give to the pipe when rivetted a slight taper, so that one section shall fit into another. The sheet of iron is introduced into the instrument sideways, and the work is performed with great apparent ease by turning a crank. The Committee considering the ingenuity and the utility of this contrivance, did not hesitate to recommend to the board to award a premium to the inventor.

2. Model of a machine for raising water at the Fair Mount water works.

The excellence of this machine has been tested upon so large a scale, and is so universally known, as to make commendation unnecessary.

3. Leaden pipes of various sizes were exhibited by Messrs. Rowley & Alberger, and Samuel Haydock.

The Committee were pleased to find that this article of our manufacture, which has become so important since the introduction of Schuylkill water, has been brought to such perfection that importation is unnecessary.

4. Rifle made at Wilkesbarre, deposited by Fletcher & Gardiner.

By this ingenious piece, two loads are fired in succession from the same barrel and by means of the same lock, so that it presents the advantage of a double barrelled gun. It is loaded in the ordinary way, except that two loads are introduced at once; corresponding to these loads are two touch holes. The lock is so constructed as to contain two primings upon a double rolling pan; the first communicates only with the forward load, and the second with that remaining. The Committee had no opportunity of trying it, but were assured that it succeeds well in practice. The lock has nearly the same arrangements as that of the double barrelled pistol with single locks. The same project of firing in succession several loads was practised during the late war; still the particular combination of this rifle we believe to be new and ingenious.

5. Model of a canal lock and boat, deposited by the Union Canal Company.

The Committee were not competent to judge of the merits of the lock. The canal boat was of the most approved construction used on the English canals.

6. Two air pumps and an electrical machine by W. & A. Mason of this city, very creditable to them as mechanics.

One of the air pumps is on the ordinary English construction. The other is a modification of that now generally adopted in Paris, having a conical stop-cock, which opens and shuts the

communication between the bands and the receiver, and between the receiver and the surrounding air. The electrical machine is small, but neatly made and ingeniously arranged.

7. Surgical instruments.

The Medical School of Philadelphia has made this an important and extensive branch of our manufactures. The beautiful specimens exhibited by Mr. Schively and by Mr. Rorer show the perfection to which our citizens have arrived in this delicate and difficult department of cutlery.

8. Seal Press made by S. V. Merrick & Co.

The mechanical power used in this press is a peculiar modification of the bent lever, first applied to this purpose by Perkins. It can be applied more rapidly than the screw, and is not so expensive. It is getting into general use in our public offices.

9. Model of a steam boat by Colonel Clarke.

This ingenious contrivance has lately excited a great deal of interest. It consists of a boat, with wheels upon its sides resembling those of a steam boat; these are acted upon by the water of the current in which they are placed, and turn a windlass, around which is wound a rope or chain attached to some point at a distance up the stream. It is evident that this will have the effect of dragging the boat up the stream. It is intended to be used in the rapids of our rivers, particularly of the Delaware, as a tow boat, for the purpose of conveying other boats over these obstacles. It has been tried frequently at the falls of Trenton, and is reported to have given general satisfaction. The Committee do not pretend to give their judgment as to the propriety of introducing it for the improvement of the navigation of our rivers, instead of the usual method of canal boats and dams.

10. Machine for pressing Leghorn and straw hats, by Benjamin B. Coston, Sober alley.

The present exhibition of the Institute has proved that the manufacture of these hats has been very successfully introduced among us, and is likely to become extensive. This machine for pressing them is therefore important and worthy of encouragement; it appears to your Committee to be extremely well adapted for the purpose for which it was intended.

11. Alarm, to be attached to a watch, by B. E. Freymuth.

This instrument is moved by being fixed to the arbor of a common watch of that construction which winds from the back. By means of a graduated line, the bell belonging to the alarm is made to ring at a set hour. The idea of using a watch for this purpose is not new, but it is believed that this mode of applying it is so, and is also ingenious.

12. Model of a tilt hammer, by W. Beach.

In this instrument the hammer is attached to each end of a long beam, which is set into a vibratory motion by the water wheel, so that the hammer strikes alternately. None of the Committee had sufficient knowledge of iron forging, to judge of the merits of this invention, but it seemed to them that the want of independence in the two hammers must be a decided practical disadvantage.

13. A clock invented by Joseph Saxton.

There has been much ingenuity displayed in the construction of this time keeper; its 'scapement is upon an entirely new principle, and it has a new kind of compensating pendulum; it was made in the shop of Mr. Philip Garrett, who had it going for two years without any oil on the 'scapement, and has found its performance excellent. The Committee think it worthy of the most particular approbation of the Board.

14. Model of a sloop of war by S. Humphreys, made by order of the Secretary of the Navy, in anticipation of an appropriation from Congress in the year 1823—4.

15. A turning lathe by Isaiah Lukens.

The Committee forbear to give their judgment on this machine, as it was made by one of their own number.

16. Weavers' reeds by Hacker, Brown & Co. of steel; Jacob Sennef, of brass; W. Orrell & Son, 502 North Second street, of steel; a weavers' harness, W. Orrell & Son, and a beautiful fly shuttle by Oren Colton, Columbia avenue.

These were all submitted by the Committee to persons capable of judging of their quality, and pronounced excellent.

17. Patent wagon, by a citizen of New Jersey.

The peculiarity of this wagon consists in an arrangement, by which the driver can at his pleasure change the place of attachment of the tongue and swingle trees, so that the lines of draught

instead of being always opposite the middle of the carriage, may be shifted from one side to the other; by this means the deep ruts may be avoided, by straddling the road as it is called, while the horses still follow the usual track; this certainly seems to be an advantage, but it is only by experience that the real utility of this invention can be tested.

18. Model of a machine for propelling boats.

The first moving power of this machine is the force of a man acting upon a winch. This, by a peculiar arrangement, gives an alternate motion to a lever which acts upon arms that push against the teeth of a cog wheel, attached to the paddles of the boat. Thus against every sound principle of mechanics, an original rotatory motion is made to communicate a final rotatory motion through the intervention of an alternate motion. This error of construction has its foundation in a strange opinion avowed by the projector, Stanislaus Chekaski, that the lever had some magical advantage over the other mechanical powers, for which reason he has forced it most unnaturally into his machine.

19. Two Scale Beams, by Solomon A. Rogers.

These beams are handsomely and carefully made, and were represented as being very sensible, even with weights of 50 or 100 pounds. The Committee regret that they had no opportunity of submitting them to a fair trial. The beam is a bar of cast steel of the same breadth and thickness throughout its length: a form which appears to be disadvantageous, inasmuch as the beam is as heavy at the ends, where there is but little stress, as at the fulcrum, where the stress is greatest. The usual form in which the beam tapers from the centre to the ends would give equal strength with much less weight. The index of the beam has attached to it a ball of metal, which moves up and down by a screw, and thus changes the centre of oscillation of the instrument. The construction of an accurate and sensible scale beam for heavy weights, is a task of much greater difficulty than is generally supposed; and it is worth from its great importance, the encouragement of the Board. The Committee would therefore respectfully propose that it should be made the subject of a premium at the next exhibition.

V. GLASS.

The specimens were very limited in number, but bear a very advantageous comparison with the finest and richest imported glass. Cut glass pitcher, decanter and tumbler from Bakewell & Co. Pittsburgh. Some from the New England Glass Company, and a retort and some excellent knobs for cabinet ware, were exhibited, all of good colour and rich workmanship. The Committee express their regret that so few articles of this description should have been exhibited, and hope that at the next exhibition the manufacturers may send samples of window glass, porter bottles, vials, and other articles. Honorary mention was awarded.

VI. POTTERY.

1. No specimens of this article were offered with a view to competition for a premium. The few articles that were exhibited were from the manufactory of Abraham Miller, Zane street, Philadelphia, consisting of red and black glazed tea pots, coffee pots, and other articles of the same description. Also, a sample of platinated or lustre pitchers, with a specimen of porcelain and white ware, all of which exhibited a growing improvement in the manufacture, both in the quality and form of the articles. It is but a few years since we were under the necessity of importing a considerable proportion of this description of ware for home consumption, but since our potters have attained the art of making it equal, if not superior to the imported, and as cheap, they have entirely excluded the foreign ware from the American market.

2. Portable earthen furnaces, from the same manufactory, rendered safe by being bound in iron hoops, are an article of great utility and convenience for culinary and other purposes.

3. Fire bricks, by James Harper, jr. are well made and appear good; but this is an article the merits of which can only be known by experience.

VII. COTTON AND LINEN GOODS.

The specimens presented were few, when we consider the great number of enterprising manufacturers in the immediate vicinity of the city. They would have been greater had the knowledge of such an opportunity of exhibiting their manufactures been more generally diffused among them.

The articles exhibited were:

1. Fine 4-4 brown shirting of New Orleans cotton, from the Dover factory, price 25 cents, well made, good fabric, the price as low as any imported of the same quality.

2. Grandurel stripe, Thomas Ford, Philadelphia, an excellent substantial article, and well calculated for general consumption.

3. Navy blue Calico, Taunton Factory.

Deposited by Hector Coffin, a very neatly finished article. Colour good, price 22 cents, rather narrower and lighter than the next sample, but preferable on the whole.

4. Same article from Charlestown factory, Massachusetts.

A very substantial fabric, full width, but not as well finished as that from Taunton; price 23 cents.

5. Same from Warren factory, Baltimore.

Deserving of much praise, and very cheap at 18 cents. All the foregoing articles will bear a fair comparison, in price, with English prints of similar appearance, and are of much more durable fabric.

6. Cottonade stripe, ¾ wide, manufactured by Samuel Slater, Oxford, Massachusetts.

A beautiful well made fancy article.

7. A specimen of blue nankeen, made in Philadelphia, deposited by A. G. Ralston,

Is a very good imitation of the imported, both in colour and quality; price 12 cents, much lower than the imported.

8. A specimen of same, deposited by Thomas & Martin.

Not so good in colour, but superior in fabric. This article bids fair to become of very great importance; considerable shipments have already been made to the South American markets.

9. Pieces of goods from the Pennsylvania Institution for the Deaf and Dumb.

Are all well made, particularly the Wilmington stripes, which deserve the highest encomiums.

10. White Satteen, made by James Ronaldson.

Price 30 cents, which the Committee think cheap, well manufactured, and calculated for extensive usefulness.

11. Two pair of Cotton Stockings, made of cotton grown on Bartram's Garden, on the Schuylkill.

Workmanship neat, and quality good, from J. Ronaldson.

12. Superior Sea-Island Shirting from the Arkwright Factory, price 25 cents.

This is superior to any thing your Committee had seen, both in style and quality; the price low.

13. Damask linen Napkins, made by the Female Hospitable Society.

Of excellent fabric, handsome patterns.

14. Cotton Stripe from the United Cotton Manufacturing Company, Providence.

Admirable for excellence of dye, and durable texture.

15. Worked Bureau Covering, by a lad 9 years old, Thomas Hansel.

Reflects much credit on the maker for his taste and industry.

16. Sea-Island shirting.

17. Cotton Plaid and Check.

18. Bed Ticking, from James Lynd.

The above were all well made and substantial, especially the bed ticking.

19. One piece of coarse cotton, from Jerome Keating & Co.

Well made.

20. Also, two bundles of cotton yarn from the same.

21. Two bundles of Cotton yarn from the Warren Factory, of better quality.

22. The Bed-quilt from William Young, wrought by a lady, very tastefully and well executed.

23. Three gross of Boot-webbing, made by J. Merrick, Hallowell, Maine.

Deposited by J. Oliver & Co. deserving of much praise.

24. Thirteen pieces of Suspender-webbing from J. Haydock, well made, and bid fair to become an extensive article of trade.

25. Three pieces of Cotton Plaid, from the Penitentiary, strong and well made.

The Committee feel gratified with the additional evidence afforded by the present exhibition, of the rapid increase of the manufacture of Cotton; at the same time they do not think that any specimens submitted to their examination are very strongly entitled to the reward of a premium.

VIII. WOOLLEN GOODS.

The samples of Woollen goods exhibited were fewer than were anticipated, from the perfection to which that branch of manufacture has attained in this country. Those offered, however, were highly creditable to the makers of Broad-cloths; they consisted in one piece of Black, and two of Blue, from B. Wells & Co. Steubenville, Ohio, one piece of Blue, from William Young, one piece of Blue, from Sykes & Co. near Baltimore, and two pieces of Blue from the Wolcott Manufacturing Company, South Bridge, Massachusetts, deposited by P. K. Hubbs.

The Committee remark that the Broad-cloths are cheaper than the imported, taking into view the quality of the wool, and weight and durability of the fabric. The piece of Blue Broad cloth manufactured by the Wolcott Manufacturing Company of South Bridge, price $4, they consider as particularly deserving of notice, on account of its cheapness. The two pieces of Blue Broad-cloth, one from Sykes & Co. near Baltimore, and the other from B. Wells & Co. Steubenville, Ohio, being decidedly the best pieces exhibited, as well for the softness and fineness of texture, richness of colour, and beauty of finish, as for their moderate prices, they consider as very perfect specimens of the manufacture. The piece from Mr. Sykes' Factory is made of wool a little superior in quality to that from Mr. Wells, and the lustre of the colour is rather better, while the latter, we conceive, exhibits more skill in the dressing; both are deserving of the highest praise, and were pronounced by many good judges to be nearly or quite equal to the best imported fabrics. Mr. Sykes' cloth, is made of Saxony wool, while that from Steubenville is

made of American wool, grown near that place. A premium was awarded to both pieces.

2. Several pieces of Cassimere were offered, all excellent, from William Young, South Third street, Philadelphia; J. Marshall, Germantown; V. & C. Dupont & Co. Wilmington, deposited by P. K. Hubbs, and B. Wells & Co. Steubenville, which, however, were not considered as challenging particular notice, except that from Steubenville, which is quite superior.

3. Two pieces of Sattinet were exhibited, one made by Austin Steele, deposited by A. G. Ralston; and one from Smithfield, deposited by Brown & Lewis. That from Steele was made from the best materials, but the other piece exhibited the greatest skill in its manufacture. Neither sample was considered as deserving of a premium.

4. Two samples of Negro cloth were deposited; one from the Pennsylvania Institution for the Deaf and Dumb, and the other from V. & C. Dupont & Co. Wilmington: both were good, but that from the Deaf and Dumb Institution was considered superior. These cloths should be wove with a coarse cotton chain, and be well nutted to be durable. Premium was awarded to the Deaf and Dumb Institution.

5. One piece of green flannel, P. Harwood.

6. One piece, made in Massachusetts, A. H. Clarke.

7. One piece white, Amesbury.

8. One piece red and two yellow, Salisbury.

9. One piece green bocking baize from Salisbury; all of which were fair specimens, and proved satisfactorily that we can supply our wants of those articles without sending to Europe. The fabric was good, the colour appeared to be excellent, and the prices very moderate.

10. Two samples of domestic carpeting were exhibited; one from Joseph Swartz, which was considered a very superior article of its kind, well woven, pattern tasteful.

11. One piece from Daniel Swartz is nearly equal to the above mentioned, and deserves much praise. Premium awarded to J. Swartz.

12. Patent floor cloth and oiled table covers from I. M'Cau-

ley were manufactured with much taste and skill, and the former is an article which is deservedly coming into more general use.

13. The hearth rug made by a lady, and deposited by William Young, exhibited considerable skill in the arrangement of the colours.

14. Specimens of beaver hats, though good, were not deserving of particular notice. One from C. H. Bulkley, two from Shelmerdine, one from Lindsay.

15. A pair of stockings and some mittens, knit at the Orphan Asylum of this city, were truly beautiful and excellent, and deserving of particular notice.

16. The gilt buttons manufactured by Leavensworth, Haydn & Scovil, were nearly as good and cheaper than English. The gilding is excellent, the finish not quite equal to the imported.

IX. LEATHER.

1. One side of sole leather from Pritchett.
2. One do. J. Ashburner and Sons.
3. One do. from J. Howell and Co.

The side from Ashburner appeared to have been managed in a very superior manner to the other specimens exhibited, which, also, were good, particularly that deposited by Pritchett.

4. The parchment by James Brady was of good quality.
5. The morocco from the same would probably have been better, had Mr. Brady known of the exhibition sooner—the well known quality of his leather warrants the assertion.

X. CABINET WARE.

Your committee regret, that while the manufacture of cabinet ware has been brought to such perfection in this city, but one article was presented in competition for premium. At the same time they must acknowledge that a number of very excellent pieces of work were sent, all of which do great credit to the makers. The articles exhibited were:

1. A table and two chairs from J. Jamison, one card table, a pair of satin wood card tables, one music stool, two maple chairs,

two settees and one mahogany stand from Charles H. White, Walnut street.

2. Two card tables made by ——— and deposited by William H. Keating.

3. Two specimens of reeded table legs, by a machine invented by Benjamin B. Coston, deserve the notice of the cabinet makers.

4. The desk made by Mr. Stiles, entitles him to much credit for the excellence of the workmanship and taste displayed throughout. A premium was awarded.

5. The tub made by a boy of ten years old, promises much for the young mechanic.

6. The sample of veneer sawing nine to the inch, by Prosper Martin, from a branch curl twenty-three inches broad, with a straight saw, was excellent.

7. The joiner's shifting plough, by C. Bartling, should be noticed by all who use the article.

It has much merit.

XI. STRAW BONNETS.

The excellence of most of the bonnets was strikingly evident, but the committee found considerable difficulty in deciding which claimed the pre-eminence, on account of their approaching so nearly in all the points of perfection. In forming their determination, the committee have taken into consideration the fineness of straw employed, the neatness of the plait and regularity of manufacture, and then the effect of all these properties in producing an article that could compete with the fine imported bonnets, in which good colour is a material point. Your committee will here remark, that in some particulars in which the bonnets were more perfect than in others, considered more essential, their judgment has been formed from the combination of materials and workmanship. Although the ornaments exhibited great elegance, they formed no criterion of decision. The articles examined were—a grass hat in imitation of leghorn, made by the pupils of the Deaf and Dumb Institution of Pennsylvania. This combines the greatest number of those properties that characterize the leghorn bonnets. The rival of the above was a

beautiful bonnet from the Fellenberg School, superior in color, but less regular in the formation. This specimen is of grass, collected in the neighbourhood of the city, by the pupils of the school. Also, a grass bonnet by Mrs. Hopkins, of Lancaster, from materials found in that neighbourhood; it is supposed this is the first time this kind of grass has been applied to this purpose, but it evidently had been too ripe when gathered; and consequently could not be properly bleached; its color therefore was not bright, but in workmanship it equalled the finest imported leghorn; there is good reason to believe, that when another season shall afford an opportunity to gather this grass in a proper state, it will prove an excellent material, especially if under the skill and care of Mrs. Hopkins.

A split straw hat by the children of the Fellenberg school appeared the best of its kind, and in the opinion of the committee possessed most of the properties requisite to a fine bonnet. A split straw hat from the Walnut street school, is a beautiful article, and does great credit to its maker; it was embellished with straw ornaments of superior elegance. Of the gimp bonnets, there were fine specimens from the Walnut street school, and the Deaf and Dumb Institution. That from the school, made by Sarah Boyer, aged thirteen, affords a striking proof of the advantage to the country of every branch of this lucrative trade, when it can be carried on to so great a perfection by such young persons.

In viewing the elegant articles assigned them, the committee find cause for congratulation in the abundant proof that Pennsylvania possesses all the requisites, materials, skill, taste and industry, to enable us to pursue, upon an extensive scale, the important business of straw manufactures. The amount of money expended in it, for our own consumption, is very considerable; but we are not to limit our views to this country; the lightness and elegance of the fabric adapt it peculiarly to a warm climate. We may look towards South America and the West Indies as furnishing a ready market for a large supply. Among the advantages which recommend this manufacture to public patronage, none are more obvious, than that it requires no capital to commence it. and that it can be pursued by infirm persons

or young children at their own houses, or in small companies, rendering it, in the literal sense of the word, a domestic manufacture, and removing the objections that exist in many institutions, of over crowding persons and children of different ages and sexes in one great concern.

The committee expressed much disappointment and surprise, that so few competitors offered themselves for the premium when there exists in our city a complaint of want of employment suited to those who could labor; while several schools have been opened where this business is taught in all its branches; and they have heard that a gentleman lately formed an establishment for this business among us, and to prosecute his object, brought a lady from a distance qualified to teach the art. A gratuitous offer was made to instruct all who should apply, and employment furnished when they were competent to it; but, in consequence of the small number who availed themselves of these advantages, he is now contemplating a removal to another state. The loss to Philadelphia and Pennsylvania, from this failure, may easily be appreciated, when you are informed that this gentleman proposed employing from ten to twelve hundred persons. That such should be the fate of any plan calculated to give honorable employment to a portion of our community, is a matter of most serious regret, and every exertion should be made to discover and remove the cause.

2. A coil of rope made at the patent factory, Boston, of a grass imported from Manilla, has also been submitted. The workmanship is regular and smooth, the rope lighter than if made of hemp. As the raw material is the most expensive part of this article, it would be well if some enterprising person would procure the seed and introduce it into this country.

3. A tortoise shell comb, exhibited by Mr. J. Pond, bore ample testimony that the maker of it was a perfect master of his business.

XII. SPECIMENS OF THE ARTS.

1. Bust of Voltaire, in plaister, good specimen of casting.
2. Specimen of bank note engraving, by Fairman, Draper.

Underwood and Co. a beautiful piece of art; the best recommendation is, that it has baffled all attempts of counterfeiters for many years.

3. Bust of Lafayette, by W. Rush.

4. Same by L. Persico.

Both excellent of their kind; as neither of these gentlemen desired to compete for a premium, it would be improper to institute a comparison between them.

5. A specimen of engraving on leather, by Edward Clarke, a substitute for wood cuts. The committee thought it ingenious, but saw no reason to prefer it to wood.

6. Meer's imitation of wood engraving on stone, by a preparation of his own discovery, is uncommonly good.

7. Carving on wood by M'Grah, a very superior piece of workmanship, deposited by R. West.

8. Same by West, very good, but not so perfect.

9. Silver pitcher, by Fletcher and Gardiner, a specimen of various kinds of chased work highly creditable to them.

10. A thirty inch silver waiter, by the same, a very difficult piece of work, and performed with much skill and excellence.

11. Silver pitcher, by Harvey Lewis, a very handsome and creditable piece of workmanship.

12. Silver coffee urn, by same, equally good.

In the manufacture of this article, Philadelphia stands unrivalled.

13. A ship from the penitentiary exhibited much skill.

14. A mantle of Egyptian, Irish and American marble, by John Struthers, 360 Market street, which the committee pronounced superior to any thing they had ever seen of the kind. Honorary mention was awarded to him.

15. A pair of mantle columns by Herkness and Smith, Pennsylvania marble, workmanship good and well polished. It is hoped these gentlemen will complete their mantle by the next exhibition.

16. Imitation of bronze, by Myer and Jones.

The color is good, but would have been better without varnish.

17. Views on the Hudson, deposited by S. Kennedy, very fine.

18. Specimens of gilding by Kennedy.

19. Same, by Earle, both highly creditable; the latter is preferable, as the ornaments are left sharp and well expressed.

XIII. PAINTS.

1. Samples of white lead were exhibited by S. P. Wetherill and Co., M. and S. N. Lewis, and John Harrison, all of which would compare with the best imported.

That from Wetherill was preferred.

2. The sample of red lead from Harrison was considered excellent.

3. The chromic yellow of Wetherill was highly approved of, and the pale yellow esteemed a very valuable color.

4. The water color cakes, made by Osborne and sold by D. B. Smith, corner of Sixth and Arch streets, were judged to be of superior quality, rivalling the best production of Europe.

XIV. FANCY ARTICLES, STATIONARY, &c.

1. Samples of paper hangings were exhibited from Messrs. Blanchard, Haley and Beatty, 151 Chesnut street, Messrs. Beck and Stewart, corner of Third and Walnut streets, and Mr. A. Chardon, 107 Walnut street.

This manufacture has arrived at great perfection in Philadelphia. On comparing samples of the French paper with those exhibited, the latter had the decided advantage in quality of glazing, size of sheets and thickness. No comparison was instituted between the American papers, as one sample only, from Blanchard and Co. was intended for exhibition, the others were taken promiscuously from the shelves.

2. Two legers were exhibited; one from D. Clarke, No. 171 Market street; an article highly creditable, and deserving of encouragement: twenty-five dollars.

3. One from R. Desilver, 110 Walnut street, binding and ruling good, paper English.

4. A stereotype bible, thirty dollars, American machine paper, from Carey and Lea; Barton's Flora, 3 vols. 4to, thirty-six dollars; Lavoisne's American Atlas, fifty-seven dollars.

These works reflect the highest credit on their enterprising publishers, H. C. Carey & I. Lea, and the different artists employed in their execution deserve much praise. The stereotype was executed by B. and J. Collins, New York, binding by B. Gaskill, some of the plates English.

5. Three prayer books by S. Potter and Co. executed in a very superior manner.

6. A maroon colored lady's work box, by William Tait, 225 Arch street.

A very beautiful specimen of fancy goods, containing all the requisite compartments for a lady's work, together with a jewel case, pocket book, and writing desk, made with much taste and skill, quite equal and as cheap as those imported, price forty dollars; a premium was awarded to Mr. Tait.

7. A gentleman's travelling case, by the same, embraces strength, portability and compactness; inside are port-folios and pockets; the front falls down and forms a desk: it is very light, and well adapted for the purpose; price fourteen dollars.

8. A small port folio, by the same, with pen and ink case in the centre; price four dollars and fifty cents.

9. A traveller's dressing case, by the same, containing sixteen requisite instruments, in a very compact form.

10. Three pieces of worked tapestry, several bead purses and card racks, by the children of the Roman Catholic Orphan Asylum.

These articles display much ingenuity and industry on the part of the infant artizans, and deserve encouragement.

11. Three bread baskets, by a little girl eight years old, 93 north Front street, very creditable.

12. A manifold writing apparatus, by J. Gilchrist, south Second street, a very useful apparatus for travellers, price ten dollars, same as imported and as good.

13. Machine paper of J. & T. Gilpin, twelve feet long, capable of being made of any length; of good materials and well made: the sample was unfinished.

14. Six bundles of playing cards, by Beck and Stewart, very well manufactured.

15. Wire, camel hair and sable hair pencils, manufactured by S. King and sold by Beck and Stewart.

The finest of them are manufactured after the French mode, and are especially made for the use of artists, and will bear a comparison with the very best imported artist's brushes. This is a valuable article in the catalogue of the arts, and until very lately no such manufacture was known in the country.

16. Tanner's Atlas.

This is a work of great merit; it contains maps of the several states of the union, drawn on a uniform scale from documents found in the public offices of the United States and State governments, and other authentic information; it contains twenty-two maps, all of which are executed in the best manner, and reflect much honor on the artist.

17. Wilson's Ornithology, published by Samuel F. Bradford.

Nine quarto volumes embellished with upwards of eighty plates, well executed and elegantly colored; printing by Robert Carr. This work forms one of the best specimens of the art in the United States.

18. Silk reel with four hundred and eighty-nine yards of raw silk from *one coccoon*, twigs with coccoons thereon, butterfly eggs, &c. of the foreign and domestic worm, from Samuel Alexander.

19. Specimens of raw silk, the produce of silk worms raised by Mrs. Heinekin, of this city, and reeled by herself.

The committee gladly embrace this opportunity of recommending the cultivation of the mulberry-tree and the rearing of the silk worm in Pennsylvania, well convinced that there is no article which can be cultivated with more ease, which will yield a more certain and large profit, and which will be so beneficial to the community at large; they earnestly recommend the subject to the early and serious attention of the Franklin Institute. Your committee feel assured that the gentlemen composing the Agricultural Society of Pennsylvania and Philadelphia, will readily co-operate in a measure of so much usefulness. The patriotic exertions of Mr. Alexander and Mrs. Heinekin deserve the thanks of the country.

XV. MUSICAL INSTRUMENTS.

1. A piano forte made by Messrs. Loud and Brothers, Philadelphia.

This instrument is a square piano of the first class, remarkable for its beauty; its tone is very pleasing, being entirely free from the harsh wiry effect often heard in these instruments. The tone was indeed so soft as to appear to us rather too much muffled; a defect which is known, however, to be in a great degree removed by a continued use of the instrument.

Mr. Loud has introduced into this piano an improvement in the action of the keys, which we think worthy of the notice of the Institute. The friction which takes place in the common English construction between the upper and under hammer is removed, by having the latter attached to the former by a small *sticker* hinged to both, on the principle employed in the action of the cabinet pianos; the hammer from its situation being more parallel to the keys, these do not require so much motion or depth of touch. Upon the whole, the committee think this instrument worthy of particular notice, but they do not recommend the awarding of a premium, because it was not subjected to a fair competition.

2. Piano forte, made by William Geib, of New York, deposited by George Willig.

This is a square piano made on the common English construction, without any extraordinary pretensions as to external appearance, but still is a neat and pretty instrument; its tone is remarkably brilliant, and is strongly contrasted with that of Mr. Loud's piano; that is, perhaps, a little too soft; this a little too shrill. This instrument was not sent to us by the maker. We hope that at the next exhibition, he will favor us with one selected for the purpose by himself.

3. A large bass drum from G. Willig.

This instrument is intended for a military band. It appeared to us to be an excellent piece of workmanship.

4. A double bass, by G. Pollard, Hallowel, Maine, from G. Willig.

This instrument, so very important in the orchestra, is made on

the best model and in the best manner; it was much admired, and certainly merits the approbation of the Institute.

5. Two flutes, by George Catlin, Philadelphia.

These are complete, highly finished, excellent instruments, believed to be equal in quality to the best that are imported.

6. A Bassoon, made by George Catlin.

This instrument possesses several improvements which we think it right to mention; these are, first, a key by which the B. natural and C. sharp in the lowest octave are produced, a difficulty which is almost invincible in the common bassoon, so that these notes, however important to the harmony, have hitherto been avoided by composers for this instrument. Second, an additional G. sharp key, which admits an easy transition from F. sharp to G. sharp, and vice versa. Without it, it is impossible to execute passages in which this transition is immediate, so that they have been avoided by composers who understood the instrument. Third, a B. flat key and D. sharp key for the second and third octaves, which offer great advantages in the execution. The instrument has also other improvements, by which many defects of the old bassoon are overcome. Its chromatic scale is perfect, from the lowest to the highest note, and the skilful amateur, to whom it belongs, has given us many opportunities of witnessing the excellence of its tone. We recommend it to the particular notice of the board. A premium was awarded to G. Catlin for this instrument.

XVI. AGRICULTURAL IMPLEMENTS.

The self-sharpening plough, by C. and O. Evans, capable of being converted into a never-dulling plough, by substituting a share of a new construction.

The best commendation this plough can receive is, that it obtained a premium from the Pennsylvania Agricultural Society at Chester. The never-dulling share appears to be an ingenious contrivance, but requires to be well tried before the committee would give an opinion on it.

The merits of Eastman's patent cylindrical straw cutter, deposited by S. V. Merrick and Co. have been satisfactorily estab-

lished by the testimony of all who have made a trial of it, and the committee find no difficulty in recommending it as a most useful machine in the economy of farming, nor in expressing their opinion that for simplicity in construction and efficiency in operation, it is superior to any straw cutter invented in this country.

XVII. MISCELLANEOUS.

A child's hat, made of skins of the ground mole, deposited by Samuel J. Robbins, a neat article.

Two thermometers, made by Fisher of this city, were creditable specimens of this branch of the arts.

A church lamp and mantle lamps, deposited by Messrs. Gardiner & Veron, 98 Chesnut street; also several deposited by J. Russell, Chesnut street. The manufacture of this article has increased very much in this city within a short period, and, from its importance, will undoubtedly soon supersede importation.

A fancy work box, by Mrs. Huddleson, of Norristown, made entirely of American materials, very tastefully executed, deposited by Mrs. Hulings.

A specimen of stereotype, from Adam Ramage, and two pages of the same from J. Ronaldson.

The art of casting stereotype plates was long kept a profound secret, but the process is now so well understood by our type founders, that they find no difficulty in executing that branch of their profession in a manner that would do credit to the art in any country.

Six specimens of painting on wood, in imitation of marble and various kinds of hard wood, by R. Hoare, 125 Spruce street, very beautifully executed.

Specimens of shot from the manufactory of P. Beck, Esq.

An arm chair made from an old elm in the State house yard, by Adam Ramage.

A model for a bee hive, deposited by Mrs. Griffith.

Specimen of graduation, 1000 to an inch, B. Stancliffe.

Pill and druggist's boxes made by R. Sprowles, New Hope.

Several specimens of lenses, spectacle glasses, &c. made by Schneitman, were considered excellent.

Annual Report of the state of the Funds of the Franklin Institute of the State of Pennsylvania, for the year ending January 10, 1825.

RECEIPTS.

From 11 Life Members, $25 each	-	-	$275	
„ 457 Members, 1st annual payment, $3 each			1371	
„ 49 do. 2d do. do.	3	„	147	
„ 52 Admission Tickets to minors	1	„	52	
„ 35 Drawing School pupils	5	„	175	
„ 6 Months dividend on Bank Stock			7	35
Total Receipts,			$2027	35

DISBURSEMENTS.

To premium and exhibition Committee -	$100	
„ Lecture Committee - - - -	300	
„ Model do. - - - -	300	
„ Sundry orders of the Board of Managers for incidental expenses - -	233	89
Total expenditure,	$933	89
Balance of Funds belonging to the Institute	1093	46
	$2027	35

Which balance is invested as follows, viz.

Deposited in Saving Fund - - -	$300	
Paid for 6 shares Mechanic's Bank Stock	210	52
Balance of cash in Treasurer's hands -	582	94
	$1093	46

Errors excepted.

THOMAS FLETCHER, *Treasurer.*

Philadelphia, January 10, 1825.

PROPOSALS

FOR THE

EXHIBITION OF 1825,

ADDRESSED TO THE

Manufacturers and Mechanics of the United States.

The managers of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, inform the manufacturers, mechanics, and artizans of the United States, that they will hold their second annual exhibition of American manufactures in the city of Philadelphia, on the 6th, 7th, and 8th of October, 1825, to which they invite all persons to send the products of their skill, ingenuity, and industry.

The success of their first experiment has impressed the Institute more strongly with the conviction of the utility of such exhibitions, and has encouraged them to continue their exertions to excite by these means, among our mechanics and artizans, an emulation which will tend to raise the reputation of our manufactures. The experience which they have acquired by their first essay will, they believe, enable them to conduct the next exhibition with increased benefits to the public, and to those who shall exhibit their manufactures.

A list of premiums is annexed which will be awarded at the close of the exhibition to the maker of such specimens as may, in the opinion of the judges, be most deserving.

The award of premiums will be made by committees appointed by the Board of Managers to decide upon each kind or branch of manufacture, conformably with the conditions annexed to each, which will, in all cases, be strictly adhered to; and the managers of the Institute reserve to themselves the right of withholding any premiums, or of bestowing such compliment as the object may be deemed worthy of.

To insure perfect impartiality in the decisions of the judges, the Institute have determined, that no committee shall award a premium to any of its members, and that no manager shall receive any premium or compliment whatever. Being unable to offer premiums for every species of manufacture which may be exhibited, the Institute will exercise the right of awarding them to articles not specified, which may be remarkable for their novelty and usefulness, or for their beauty and perfection in workmanship. Proof of origin will be required to accompany every specimen offered for premium. No article intended for competition will be received after Saturday, October 1. This provision is indispensable to enable the committee to make a suitable arrangement. Much inconvenience was experienced at the last exhibition from the contributors withholding their specimens until it was opened. The name and residence of the maker must be affixed to each article, and as far as possible, the price at which it can be sold. The committee of arrangement, or an auctioneer who will be provided by them, will make sales of all articles of which it may be the desire of the owners to dispose. No premium will be awarded by the Franklin Institute to any article which has received one at another public exhibition, and none can receive a premium at the second exhibition which is not equal in quality to the best specimens of the same article deposited at the first; samples of which have been kept as far as practicable. Whenever the price is made a condition of premium, the makers must engage to furnish the required quantity at the terms affixed.

Any articles intended for exhibition, may be deposited at the Hall of the Institute, after the first of August next.

Persons desiring further information, may address themselves by letter (free of postage) to any member of the committee, who will reply to all such communications.

List of Premiums offered by the Franklin Institute of the State of Pennsylvania, and to be awarded at their second annual exhibition in October, 1825.

1. To the maker of the best cast steel manufactured in any state of the Union. A specimen of at least ten pounds, in bars

of one half inch square, or smaller, must be exhibited, with a certificate that at least one hundred pounds have been made. The quality of the steel, and the neatness of the bars, will be taken into consideration in estimating its merit—*A silver medal.*

2. To the maker of the best blistered steel manufactured in the Union, from American materials. A specimen of at least one hundred pounds must be exhibited, together with a certificate that at least one ton of the same quality has been made. The steel must be capable of receiving a fine edge—*A gold medal* will be awarded in case the sample is superior to any imported. If it be not superior, but will bear a fair comparison with that imported, it will be entitled to *a silver medal.* But no premium will be awarded unless the sample be superior to that exhibited in 1824.

3. To the manufacturer of the best bar iron made in Pennsylvania—*A silver medal.* The iron to be of a suitable quality for the purpose of converting into steel. Specimens of not less than one hundred pounds must be delivered on or before the first of September.

The Institute having observed with regret, that a practice prevails among iron masters, to leave a portion of crude metal at the end of their bars, forming what is termed a *fag*, the competitors for this premium are informed that the neatness of the bars will be considered, and that no bar presenting a fag end will be received for competition. The manufacturers must state on what terms they would engage to deliver fifty tons of such iron, without a fag, if desired.

4. To the maker of the best specimen of cast iron pipes manufactured in the United States: samples not to be less than one hundred feet, of one inch caliber, in sections of at least four feet long—*A silver medal.*

5. To the maker of the best smith's anvil, steel faced, weighing not less than seventy pounds—*A silver medal.* The anvil made in any state of the Union.

6. To the maker of the best japanned goods; the basis American sheet iron, the japanning done in Pennsylvania—*A silver medal.* In awarding this premium, the quality of the japanning,

the taste of the designs, and the finish of the samples, will be taken into consideration.

7. To the person who shall have made in Pennsylvania the greatest quantity of copperas, in the year ending September 1st, 1825; the quantity not less than five tons—*A silver medal.*

8. To the person who shall have made in Pennsylvania the greatest quantity of alum, during the year ending September 1st, 1825, the quantity not less than five tons—*A silver medal.*

9. To the maker of the best green colour, suitable for the general purposes of painting. Certificates of the colour's resisting the action of the atmosphere will be required: the colour to be made in any part of the United States; samples of not less than five pounds must be exhibited—*A silver medal.*

10. To the maker of the best water colours manufactured in the United States—*A silver medal.*

11. To the maker of the best crucibles of earthenware, or other cheap material, suitable for brass founders. The crucibles must be able to resist heat as well as those made of black lead, and to stand at least seven heats in a brass-founder's furnace. They must be capable of holding at least forty pounds of metal: one dozen of crucibles must be exhibited, together with a certificate of their having been made in the United States—*A silver medal.*

12, 13, 14. To the makers of the best pottery of red and white earthen, and China wares, from American materials—For each a *bronzed medal.*

15. To the maker of the best glassware, not cut. An assortment of different articles will be expected, and the estimate of the merit of each manufacturer will be formed upon an examination of all the articles furnished by him—*A silver medal.* The glass to be of American manufacture.

16. To the manufacturer of the best cut glass, made in the United States—*A silver medal.* In awarding this premium, regard will be had to the quality of the glass, as well as to the skill and beauty of the cutting.

17. To the manufacturer of the best piece of blue broad cloth, made in the United States from wool of American growth; not

less than ten yards to be exhibited—*A silver medal.* Regard will be had to the quality of the dye, as well as of the cloth.

18. To the manufacturer of the best piece of cheap broad cloth, made in the United States from wool of American growth, *A silver medal.* As regard will be had to the lowness of the price, as well as to the quality of the cloth, this premium will not be awarded unless assurance be given, that any quantity, not exceeding five hundred yards, of similar quality, will, if required, be furnished at the same price.

19. To the manufacturer of the best piece of negro cloth; not less than one hundred yards to be exhibited—*A silver medal.* The cheapness at which this cloth will be offered, will also be considered; hence the premium will only be awarded on assurance being given that a quantity, not exceeding two thousand yards, of the same quality, will be furnished at the same price, if required.

20. To the maker of the best piece of cassimere manufactured in the United States from American wool; a specimen of not less than ten yards to be exhibited---*A silver medal.*

21. To the manufacturer of the best piece of flannel made in the United States; not less than forty yards to be exhibited —*A silver medal.* Assurance must be given that three hundred yards at the stipulated price will be furnished if required.

22. To the manufacturer of the best piece of green baize, made in the United States—not less than fifty yards to be exhibited—*A bronzed medal.*

23. To the maker of the best woollen blankets, made in the United States; one dozen pair to be exhibited—*A silver medal.* The blankets to be from two to four points; regard will be had to the weight, and no premium awarded unless the quality be equal to that of the imported article.

24. To the maker of the best specimen of ingrain carpeting; —*A silver medal.* A piece of not less than twenty yards to be exhibited, with a certificate of its having been made in the United States, from American materials.

25. To the maker of the best piece of domestic carpeting, made in Pennsylvania, not less than twenty-five yards to be exhibited; and as cheapness is an object, the price must be affixed

to the samples. No person shall be entitled to this premium unless assurance be given that any quantity not exceeding one hundred yards may be obtained of the same quality, and at the same price—*A bronzed medal.*

26. To the maker of the best piece of oil cloth, fit for carpeting, made in the United States; not less than twenty-five yards to be exhibited—*A bronzed medal.*

27. To the maker of the best piece of satinet, made in the United States; not less than twenty yards to be exhibited—*A silver medal.*

28. To the maker of the best piece of blue nankeen, made in the United States, in imitation of the Chinese; not less than five pieces to be exhibited—*A silver medal.*

29. To the manufacturer of the best specimen of yellow nankeen, made in the United States, in imitation of the Chinese; not less than five pieces must be exhibited—*A silver medal.*

30. To the manufacturer of the best specimen of furniture calicoes, (chintzes) made in the United States; not less than fifty yards to be exhibited—*A silver medal.*

31. To the manufacturer of the best specimens of calicoes or prints, for ladies' dresses, made in the United States; not less than fifty yards to be exhibited—*A silver medal.*

32. To the manufacturer of the best specimen of Salempore, manufactured in the United States, in imitation of the imported; not less than ten pieces to be exhibited—*A silver medal.* In estimating this article the colour as well as the texture will be considered.

33. To the manufacturer of the best cotton cloths, of superfine quality, in imitation of English cambric muslin—*A silver medal.*

34. To the manufacturer of the best specimen of cotton thread, in imitation of English wire cotton; not less than forty pounds to be exhibited—*A silver medal.*

35. To the manufacturer of the best loom cotton stockings; not less than one dozen pair to be exhibited—*A silver medal.*

36. To the manufacturer of the best specimen of linen shirting, made in the United States—*A silver medal*; not less than fifty yards to be exhibited.

37. To the maker of the best specimens of gilt buttons, of

American manufacture; not less than five gross to be exhibited —*A silver medal.*

38. To the maker of the best specimens of sole leather, made in the United States; not less than twenty-five sides to be exhibited—*A bronzed medal.*

39. To the maker of the best specimen of morocco made in the United States; not less than twelve pieces of each colour to be exhibited—*A bronzed medal.*

40. To the maker of the best specimen of leather, prepared in the United States, in imitation of Russia; not less than twelve pieces to be exhibited—*A bronzed medal.*

41. To the maker of the best specimen of parchment, manufactured in the United States; not less than twelve pieces to be exhibited—*A bronzed medal.*

42. To the maker of the best buckskin gloves, the leather dressed in the United States, the gloves made in Pennsylvania; not less than a dozen pair to be exhibited—*A bronzed medal.*

43. To the maker of the best kid or sheepskin gloves, the leather dressed in the United States, the gloves made in Pennsylvania; not less than a dozen pair to be exhibited—*A bronzed medal.*

44. To the maker of the best horse skin gloves, made in the United States; not less than a dozen pair to be exhibited—*A bronzed medal.*

45. To the manufacturer of the best japanned leather, prepared in the United States—*A bronzed medal.*

46. To the manufacturer of the best upright or cabinet piano—*A silver medal.*

47. To the manufacturer of the best horizontal piano—*A silver medal.*

48. To the maker of the best specimen of cabinet ware executed in Pennsylvania—*A silver medal.* In awarding this premium, regard will be had to the excellence of workmanship, and to the taste and design manifested in the specimens.

49. To the maker of the best straw bonnet, manufactured in Pennsylvania—*A silver medal.*

50. To the maker of the best Leghorn or grass bonnet, manufactured in Pennsylvania—*A silver medal.*

51. To the person who shall have produced and reeled during the year ending October 1, 1825, in Pennsylvania, the greatest quantity of raw silk, not less than ten pounds—*A silver medal.*

52. To the manufacturer of the best specimen of paper hangings prepared in the United States—*A silver medal.* In awarding this premium, regard will be had to the texture, design and glazing, and no premium granted unless the specimens be equal to the best imported.

53. To the maker of the best specimen of cutlery made in Pennsylvania, from American materials—*A silver medal.* In awarding this premium, regard will be had to the merit of all the articles sent by the same maker.

54. To the inventor of the best constructed grate, for burning anthracite—*A silver medal.* The object of this premium is chiefly to obtain a grate suitable for domestic purposes, which will unite convenience with economy, and which may be used for cooking. Tastefulness of design, though not a primary object, will be consulted as far as is compatible with economy. Certificates will be required of the grate's having been in use for some time, of the quantity of coal which it consumes, and of the effect which it produces.

55. To the inventor of the best constructed furnace, for consuming anthracite in generating steam, to be applied to steam engines—*A silver medal.* Certificates will be required of the furnace having been in use some time, of the quantity of coal consumed, and of the effect produced.

56. To the person who shall have manufactured, in Pennsylvania, the greatest quantity of iron from the ore, using no other fuel but anthracite, during the year ending September 1st, 1825; the quantity not to be less than twenty tons—*A Gold medal.*

57. To the person who shall have manufactured, in Pennsylvania, the greatest quantity of iron from the ore, using no other fuel but the bituminous coal, (or the coke obtained from it) during the year ending September 1st, 1825. The quantity not to be less than one hundred tons—*A Gold medal.*

58. To the person who shall have manufactured in Pennsylvania, during the year ending September 1st, 1825, the greatest quantity of iron pigs or castings, from the clay iron stone, or ar-

gillaceous carbonate of iron. (This is the ore which is often found in the slate accompanying bituminous coal, and which, in several parts of Pennsylvania, is designated by the local appellation of blue ore)—*A Gold medal.*

59. To the author of the best treatise (whether manuscript or printed, subsequently to the 20th of October, 1824,) on the construction of water wheels. In appreciating the merits of such treatises, regard will be had to procuring the greatest effect with the water employed, and to freeing the wheels from back water —*A silver medal.* It is important also that the descriptions should be intelligible to common workmen.

60. To the author of the best dissertation, (whether printed or manuscript) explaining the causes of accidents in steam boilers and the means of avoiding them. The dissertation must contain more information than is now before the public; it must be founded upon experiments, and written in a clear and lucid manner—*A silver medal.*

61. To the author of the best treatise (whether manuscript or printed, since the 20th October, 1824,) on dying cloths—*A silver medal.*

62. To the maker of the best and most perfect scale beam, capable of weighing at least twenty pounds; the beam made in the United States—*A silver medal.*

63. To the maker of the best mill or press screw, of wrought iron, for the purposes of clothiers, printers, bookbinders, &c. not less than 2 5-8 inches in diameter, and of the usual length. It must perform its revolutions in the box without variation at the lower end or pressing point. The box to be also of wrought iron—*A silver medal.*

64. To the manufacturer in the United States, of the best specimen of writing paper, in imitation of the Bath post—the paper to be equal to the best imported—*A silver medal.*

65. To the inventor of the most perfect stopcock, suitable for air-pumps, and intended to be placed in the course of a tube, so as to open or close the communication through it. The object of this premium is to obtain a stopcock that shall answer as well for the middle of a tube as the screw and leather do for the end of it—*A silver medal.*

66. For the best dissertation on the loss of power caused by the conversion of an alternate into a rotatory motion, by means of the ordinary crank—*A silver medal.*

67. To the maker of the best iron hoops, 5-8th of an inch wide; the requisite qualities to be smoothness and lightness. The maker to exhibit not less than one Cwt., and to give assurance to furnish any quantity that may be required, not exceeding twenty tons, of the same quality, and at a price not exceeding $8. 75 per hundred—*A silver medal.*

68. To the person who shall have made in Pennsylvania, the best cast steel rollers, suitable for the purposes of silversmiths —*A silver medal.*

69. To the person who shall have made in the United States, within the last year, the greatest number of hydrostatic presses, (the number not less than three,) and who shall furnish the Institute with an account of their power and of their price—*A silver medal.*

70. To the person who shall discover a cheaper mode of making machine cards than those now in use, or who shall discover a mode of making them more durable—*A silver medal.*

71. To the person who shall have made in Pennsylvania, during the year ending September 1, 1825, the largest quantity of fire bricks, equal in quality to the imported, and not exceeding in price five dollars per 100—*A bronzed medal.*

72. To the person who shall invent and make known the best substitute for copper in the sheathing of ships; the invention to be better than any at present known, and its merit to have been tested by experience—*A silver medal.*

73. To the person in the United States who shall have made the greatest quantity of chain cables or ship chain rigging, not less than five tons—*A silver medal.*

74. To the person who shall have made in Pennsylvania, the greatest quantity of sail cloth, either of cotton, flax or hemp; the quantity not less than twenty bolts—*A silver medal.*

75. To the person in the United States who shall have invented an apparatus practically superior to any now in use for heaving up a ship's anchor—*A silver medal.*

76. To the person who shall indicate to the Institute, a me-

thod better than any in use, to protect timber in ships, or other works, against the effects of the dry rot. The process must be such as can be applied on a large scale, without too great an expense—*A silver medal.*

77. To the person who shall have made in Pennsylvania, the greatest quantity of oil from any vegetable raised in this state. The oil must be of a quality suitable to be used as a substitute for Florence or olive oil; the quantity obtained not to be less than twenty gallons—*A silver medal.*

78. To the maker of the best mechanics' edge tool made in Pennsylvania—*A Silver medal.*

79. To the maker of the best cast brass cylinder for calico printing—*A silver medal.*

80. To the maker of the best specimen of sheet brass; not less than twenty sheets must be exhibited—*A silver medal.*

81. To the maker of the best brazier's copper, not less than twenty sheets to be exhibited, (thirty by sixty inches,)—*A silver medal.*

82. To the maker of the best raised copper bottoms, suitable for stills or boilers, not less than thirty inches in diameter—*A silver medal.*

83. To the maker of a hydrant that shall be adjudged superior in principle to any now in use—*A silver medal.*

☞ *Editors of Newspapers throughout the United States, friendly to the cause of the arts, will please to publish these premiums in their papers.*

On behalf of the Institute.

JAMES RONALDSON,
ADAM RAMAGE,
WILLIAM H. KEATING,
SAMUEL V. MERRICK,
WILLIAM KNEASS

Committee on Premiums and Exhibitions.

Philadelphia, January 29, 1825.

THE FRANKLIN INSTITUTE.

STATED MONTHLY MEETING OF THE FRANKLIN INSTITUTE, WEDNESDAY, MARCH 16, 1949.

The Stated Monthly Meeting of The Franklin Institute was held Wednesday evening, March 16, 1949 in the Lecture Hall of the Institute with Mr. Richard T. Nalle, President, in the chair.

The President called the meeting to order and announced that the minutes of the Stated Monthly Meeting for February had been printed in full in the March issue of the Journal of The Franklin Institute and would stand approved as printed if there were no corrections. There was no dissent. The President called for a report from the Secretary.

In his report the Secretary announced the following report on Membership for the months of January and February:

Sustaining	1
Active	69
Associate	41
Student	33

The total membership as of February 28 was reported to be 5430.

A brief summary of the current activities of the Institute was presented. The Secretary stressed the festivities scheduled to take place on April 20th commemorating the 125th Anniversary of the founding of The Franklin Institute and the 200th Anniversary of Benjamin Franklin's Electrical Experiments. These festivities will take the form of a luncheon followed by talks by Dr. Robert A. Millikan and Dr. C. Guy Suits. In the evening there will be a Reception and Dinner followed by a "Story of The Franklin Institute" which will be delivered by Mr. James H. Robins, President of The American Pulley Company.

President Nalle introduced Dr. W. F. G. Swann, Director of the Bartol Research Foundation of The Franklin Institute, who spoke on Atomic Particles and their activities.

HENRY B. ALLEN,
Secretary.

MUSEUM.

When The Franklin Institute was organized one hundred and twenty-five years ago, the founders resolved upon furnishing "a cabinet of models and minerals." This was the germ from which the present great Museum has sprung.

It has always been the boast of the members that the Institute has kept abreast of the changes in technology at all stages of its existence but it may seem confusing to suggest the "cabinet" mentioned was the forerunner of the greater conception, or that it bore any resemblance to an effort that would inform members of the latest stages of technical knowledge. However, it is necessary that we look at things in the proper perspective.

When we look back upon the period in which the Institute was founded we perceive an aspect of national economy completely at variance with that which prevails today. The factory system was in its infancy, most manufacture was accomplished by means of hand-tools. The principal means of earning a livelihood were associated with the sea and the cultivation of the soil. The movement toward the West had set in which had little effect upon agricultural methods, although it did modify the national economy by creating a demand for "store goods" and increased the needs for better methods of transportation. While creating these new demands in the East, the migration of workers to the West depleted the reservoir of man power available for industry.

On the other hand, it greatly stimulated the desire to explore the nation's natural resources. Minerals, especially copper, were eagerly sought. When one reads the accounts of debates in Congress at the time, the reader will seek in vain for any proposal to promote schemes which would advance the study of science or industry. There was still a reluctance to grant extensions of patents, based upon the fear of creating an aristocracy of industrial wealth. But Congress was rarely reluctant to furnish the funds for undertaking surveys of the rapidly expanding territory that came under development. The staffs of these surveys were re-inforced by the addition of some technical members whose duty was to furnish information upon the botany or the minerals of the area under investigation.

The work of the botanists was largely confined to describing and classifying their finds, but there was a promise of direct and immediate value in the reports of the geologists. Because of the practical value of the discovery of workable minerals, the founders of The Franklin Institute were resolved upon enabling any aspiring student to become familiar with the subject. The counterpart of the idea today is the Periodic Table in the Chemistry Section, which shows the ores from which the various chemical elements are extracted.

The collection of models still perseveres. For space reasons it is impracticable to display many airplanes or locomotives of operating sizes. The story of their development must be told by models. But the idea of the founders bore fruit in the form of gifts of models and equipment which have acquired precious historical value. Only a few of these can be singled out for mention, but Franklin's electrical machine, Priestley's air pump, the model of Oliver Evans' "Columbian" engine made by his nephews, the tiny Chambers' steam engine (just one hundred years old this year), and Mr. Greville Bathe's model locomotives should not be overlooked.

When the time came to organize the great scientific museum on its present site, the collection was greatly enriched with specimens of models and articles in current use. It should not be forgotten that in the inevitable course of events these are gradually acquiring the patina of an honored age, and as developments descend upon us with bewildering frequency these models are assuming the characteristics associated with the historical past of technology.

MEMBERSHIP.

ACTIVE MEMBERS ELECTED AT THE MEETING OF THE BOARD OF MANAGERS, MARCH 16, 1949.

ACTIVE FAMILY.

John J. Byrne, M.D.
Calvin S. Drayer, M.D.
D. M. Fleming
H. Boas Maguire
Valentine R. Manning, Jr., M.D.
Edwin B. McLean
Robert K. Price

ACTIVE.

Richard L. Burke
William Cairns
Leon M. Carp, M.D.
Charles C. Chapple, M.D.
Charles W. Charny, M.D.
Harold Dwell
Capt. Earl F. Enright, USN (Ret.)
David H. Harshaw
Robert J. Kressler, M.D.
David H. Lauder
Bruce V. MacFadyen, M.D.
Russell K. Mattern, M.D.
John T. McLaughlin, M.D.
Ronald R. Monroe
William A. Morley
E. F. Pain
Edward Pickert, M.D.
Philip W. Souder
Herbert W. Stuart
Harry S. Weaver, Jr., M.D.
Albert E. Welsh, Jr., M.D.
Horace James Williams, M.D.

ACTIVE NON-RESIDENT.

Bruce E. Anderson
George W. Baughman

NECROLOGY.

F. Wallis Armstrong, '36
Francis M. Brooke, '44
Mrs. R. S. McGowin, '36
Horace F. Nixon, '36
Mrs. Horace F. Nixon, '36

COMMITTEE ON SCIENCE AND THE ARTS.

(Abstract of Proceedings of Stated Meeting held Wednesday, March 9, 1949.)

HALL OF THE COMMITTEE,
PHILADELPHIA, MARCH 9, 1949.

MR. W. LAURENCE LEPAGE in the Chair.

The following report was presented for final action:

No. 3202: Franklin Medal.

This report recommended the award of a Franklin Medal to The Svedberg, of the University of Upsala, Sweden, "In consideration of his development of the ultracentrifuge, of his development of methods for use of the ultracentrifuge in determining molecular weights and the distribution of molecular weights, of high molecular weight proteins, and in consideration of his inspiring leadership of others in the field of colloid chemistry."

JOHN FRAZER,
Secretary to Committee.

LIBRARY.

The Committee on Library desires to add to the collections any technical works that members would wish to contribute. Contributions will be gratefully acknowledged and placed in the library. Duplicates received will be transferred to other libraries as gifts of the donor.

Photostat Service. Photostat prints of any material in the collections can be supplied on request. The average cost for a print 9 × 14 inches is thirty-five cents.

The Library and reading room are open on Mondays, Tuesdays, Fridays, and Saturdays from 9 A.M. until 5 P.M., and Wednesdays and Thursdays from 2 P.M. until 10 P.M.

RECENT ADDITIONS.

AERONAUTICS.

The Army Air Forces in World War II. Volume I. 1948.

ARCHITECTURE AND BUILDING.

JORDAN, RICHARD C. AND PRIESTER, GAYLE B. Refrigeration and Air Conditioning. 1948.

CHEMISTRY AND CHEMICAL TECHNOLOGY.

BOOTH, A. D. Fourier Technique in X-ray Organic Structure Analysis. 1948.
DRUCE, J. G. F. Rhenium. 1948.
JOHNSON, B. CONNER. Methods of Vitamin Determination. 1948.
MELVILLE, H. W. The Chemistry of High Polymers. 1948.
ROTHERY, WILLIAM HUME. Electrons, Atoms, Metals and Alloys. 1948.
SCHENCK, HERMANN. Introduction to the Physical Chemistry of Steelmaking. 1945.
SMITH, FREDERICK J. AND JONES, EMLYN. A Scheme of Qualitative Organic Analysis. 1948.
WILLARD, HOBART H.; MERRITT, LYNNE L.; AND DEAN, JOHN A. Instrumental Methods of Analysis. 1948.

ELECTRICITY AND ELECTRICAL ENGINEERING.

CADY, W. M.; KARELITZ, M. B.; AND TURNER, LOUIS A. Radar Scanners and Radomes. 1948.
MONTGOMERY, C. G.; DICKE, R. H.; AND PURCELL, E. M. Principles of Microwave Circuits. 1948.

ELECTRONICS.

Advances in Electronics. Volume I. 1948.
CHANCE, BRITTON AND OTHERS. Waveforms. 1949.

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BURTON, WALTER E. Engineering with Rubber. 1949.

MANUFACTURE.

FISCHER, WILLIAM VON. Paint and Varnish Technology. 1948.
RIGSBY, H. P. Welding Fundamentals. 1948.

MATHEMATICS.

MILNE, EDWARD ARTHUR. Vectorial Mechanics. 1948.
WILKS, SAMUEL STANLEY. Elementary Statistical Analysis. 1948.
ZARISKI, O. Algebraic Surfaces. 1948.

MECHANICAL ENGINEERING.

ALBERT, CALVIN DODGE. Machine Design Drawing Room Problems. Fourth Edition. 1948.
COLVIN, FRED HERBERT AND STANLEY, FRANK A. Drilling and Surfacing Practice. Third Edition. 1948.
COLVIN, FRED HERBERT AND HAAS, LUCIAN L. Jigs and Fixtures. 1948.
FRAAS, ARTHUR. Combustion Engines. 1948.
JUDGE, ARTHUR W. Automobile and Aircraft Engines. Fourth Edition. Volume I. 1947.
MACCONOCHIE, ARTHUR F. Kinematics of Machines. 1948.
WOOLRICH, W. R. AND BARTLETT, LUIS H. Handbook of Refrigerating Engineering. Third Edition. 1948.

PATENTS.

ROSSMAN, JOSEPH. The Psychology of the Inventor, a Study of the Patentee. 1931.
SCHER, V. ALEXANDER. Patenting the Invention. 1948.
TOULMIN, HARRY A. How to Keep Invention Records. 1948.

PHOTOGRAPHY.

NEWCOMBE, H. S. 35 mm. Phototechnique. 1948.
THOMSON, C. LESLIE. Color Transparencies. 1948.

PHYSICS.

BOUMA, P. S. Physical Aspects of Colour. 1947.
COOPER, HERBERT J. Scientific Instruments. Two Volumes. 1948.
GREENLEES, A. E. The Amplification and Distribution of Sound. Second Edition. 1948.
HABELL, K. J. AND COX, ARTHUR. Engineering Optics. 1948.
KEENAN, JOSEPH H. AND KAYE, JOSEPH. Gas Tables. 1948.
MISES, RICHARD VON AND KARMAN, THEODORE VON. Advances in Applied Mechanics. Volume I. 1948.
SIBERT, HAROLD W. High Speed Aerodynamics. 1948.
TOLANSKY, S. Multiple Beam Interferometry of Surfaces and Films. 1948.

PLASTICS.

SIMONDS, HERBERT R.; WEITH, ARCHIE J.; AND BIGELOW, M. H. Handbook of Plastics. 1949.

RADIO.

RADIO CORPORATION OF AMERICA. Frequency Modulation. Volume I. 1948.
RADIO CORPORATION OF AMERICA. Radio at Ultra High Frequencies. Volume II. 1948.

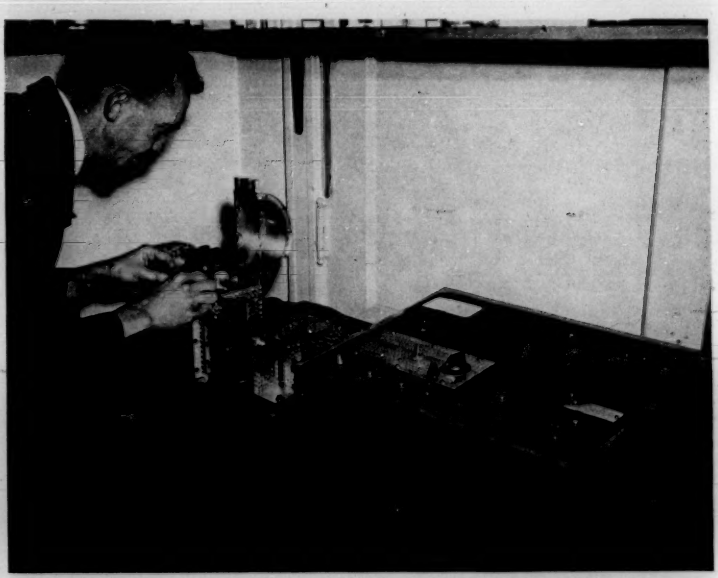
STEAM ENGINEERING.

KEARTON, WILLIAM J. Steam Turbine Theory and Practice. 1948.

THE FRANKLIN INSTITUTE LABORATORIES FOR RESEARCH AND DEVELOPMENT.

THE ULTRA-MICROTOME. *

The ultra-microtome is an instrument which is capable of slicing materials thin enough to be viewed directly in the electron microscope. The cutting is done by a small steel knife, mounted on a rotor, which can be run at any speed up to 60,000 rpm. The sample is mounted in a small chuck and fed into the knife by a motor whose speed can be controlled independently.



Mounting specimen in the ultra-microtome.

Abstract of **A New Method of Sectioning Synthetic Fibers with the Ultra-Microtome for Examination with the Electron Microscope.**[1]—MARSHALL D. EARLE [2] AND JEAN A. MINKIN.[3] A method has been devised in which a piece of rayon or nylon yarn, consisting of 10 or 20 single filaments, is prepared for sectioning with the high-speed ultra-microtome in such a way that the boundaries of individual filaments can be identified when viewed in the electron microscope. The yarn is mounted in a special holder in which the filaments are spread out radially. They

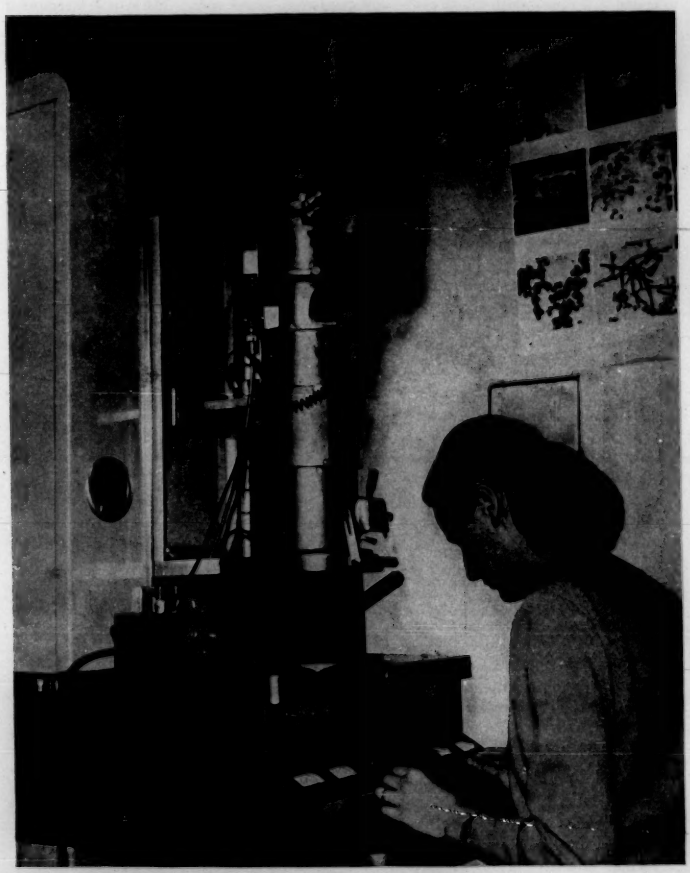
* The research work on which subject abstract and paper were based was supported by a research grant by the Custom Scientific Instruments, Inc., maker of the ultra-microtome, to The Franklin Institute Laboratories for Research and Development.

[1] Paper presented before the Electron Microscope Society of America by Dr. Marshall D. Earle and Mrs. Jean A. Minkin in Toronto, Canada, September 10, 1948, and published in the January, 1949 issue of *Textile Research Journal.*

[2] Research Physicist, The Franklin Institute Laboratories for Research and Development, Philadelphia, Penna.

[3] Research Assistant, also of The Franklin Institute Laboratories staff.

are then coated with a thin film of evaporated gold in the vacuum unit. These filaments are allowed to fall parallel to each other again. They are embedded in a very thin layer of low-melting-point paraffin and sectioned with the ultra-microtome. The thin film of gold enables one to determine whether the area being studied is near the surface of the filament.



Examining sample in the electron microscope.

USES OF THE ELECTRON MICROSCOPE, PRESENT AND POTENTIAL.

In ten years of use the electron microscope has proved applicable to a very wide range of problems. Workers in the fields of chemistry, physics, metallurgy, and biology have been aided in much of their research by the high magnification and resolving power achieved with this instrument. Useful magnifications up to 200,000 × can be attained and particles separated by less than 50 Angstroms can be resolved.

For the chemist and the physicist the electron microscope provides information regarding the size, shape, and structure of various solid particles such as catalysts, pigments, and filter materials, so that they may correlate physical form with other properties.

In metallurgical work, the electron microscope serves to extend the studies of the physical structure of metal surfaces made with conventional metallographic microscopes. In the case of the electron microscope, surfaces of solid materials must be studied indirectly by the use of replicas, because of the low penetrating power of the electron beam. The thin replicas used give a faithful reproduction of the surface structure and are penetrable by the electron beam, so that the image obtained is identical with that seen in a metallographic microscope, except that the former has greater resolution. Problems in age hardening, fatigue, corrosion, etc., will perhaps soon be better understood through the aid of electron microscopical studies.

Replica techniques have also proved useful in studies of various polished surfaces, as well as the surfaces of materials such as glass and natural and synthetic fibers.

It is in the biological world that electron microscopy is perhaps making its greatest contribution to the benefit of mankind. Many viruses and bacteria heretofore invisible, since they are too small to be observed with the light microscope, have been studied in detail with the electron microscope. Informative studies of bacterial structure, flagella, bacteriophage action, cell processes, muscle and nerve fiber structure, and normal and diseased cells, have already been conducted. The future promises much progress along these lines.

With further improvement in the techniques of obtaining thin (about 0.1 micron) sections of materials, still in the early stages of development, valuable information may be obtained about the structure of tissue, fibers, plastics, etc., and the dispersion of particles in solid surrounding media. Already, through the study of sections obtained with the high-speed ultramicrotome, problems such as the dispersion of filler particles in rubber and the structure of synthetic fibers have been attacked with some degree of success.

The electron microscope to date has served to extend the scientist's sense of vision beyond the limit of the light microscope down to the dimensions of the larger molecules. In the future, with further improvement of the instrument, man may perhaps be able to peer even further into the realm of molecular and atomic dimensions.

NOTES FROM THE NATIONAL BUREAU OF STANDARDS.*

NEW HELIUM LIQUEFIER IN LOW-TEMPERATURE RESEARCH.

Remarkable phenomena have been observed at temperatures near absolute zero, a region that is becoming increasingly important in many fields of scientific investigation. The National Bureau of Standards, in cooperation with the Office of Naval Research, is now conducting a program of basic research on the properties of matter at these extremely low temperatures. Liquid helium, with its unique low boiling point of 4.7° K., is indispensable in low-temperature research. An important phase of the research has therefore been the development of an improved helium liquefier, one of the principal features of which is a transfer siphon for delivering the liquid helium to an external receiver. The liquefier, designed by R. B. Scott of the Bureau's Cryogenics Laboratory, promises to aid materially in other phases of the work, which include a study of superconductivity and an experimental determination of the properties of helium II.

At the temperature of liquid helium, metals such as lead and tin, which are ordinarily poor conductors of electricity become superconductors with a complete disappearance of electrical resistance. Soon after discovery of this phenomenon in 1911, it was found that resistance reappears when a large electric current is sent through a superconductor or when a sufficiently strong magnetic field is applied. In 1918, Dr. F. B. Silsbee of the Bureau staff postulated that resistance is restored when the magnetic field reaches a critical value, regardless of whether the field is applied externally or is caused by the current in the conductor. The Silsbee hypothesis has been verified for pure metals in numerous experiments; alloys, however, are an interesting exception. In a further analysis based on electromagnetic theory, he predicted that there would be no resistance until the current reached the critical value; the resistance would then rise suddenly to one-half the "normal value" (its value just above the superconducting transition temperature); and, upon further increase of current, the resistance would rise gradually to approach the normal resistance.

Because this theory had not been confirmed experimentally, it was one of the first problems to receive attention after the new helium liquefier had been perfected. Straight lengths of indium wire of three different diameters were immersed in liquid helium until they became superconducting. Resistance was then obtained as a function of current for each specimen at several temperatures. Although a sudden rise of resistance was observed when the current reached a critical value,

* Communicated by the Director.

its magnitude was not one-half of the normal resistance as predicted, but instead was 77 to 85 per cent. Furthermore, the percentage of normal resistance that reappeared at the critical value varied inversely with the size of wire whereas the theory does not indicate dependence on specimen diameter.

The disagreement with theory adds interest to the experimental results. Theoretical investigations on the nature of the intermediate state of superconductors have pointed out in a qualitative way some of the shortcomings of the earlier theory, but a quantitative treatment has not yet been worked out.

Another aspect of superconductivity research at the Bureau is the behavior of superconductors at microwave frequencies. With low-frequency or direct currents, superconductors show a complete loss of resistance, and at optical and infrared frequencies the superconducting state does not occur. The microwave region remains as a kind of twilight zone, in which the metals lose only a portion of their resistance at low temperatures.

At 2.19° K., ordinary liquid helium (He I) undergoes a transition to helium II (He II) with a radical alteration of many of its properties. At the transition temperature the thermal conductivity of He I increases very abruptly to an apparent value for He II much greater than that of any other substance. This is because heat is propagated in He II as a kind of wave motion analogous to sound and known as "second sound," whereas in other materials heat flow is purely a diffusion phenomenon. He II also acts as though it has no viscosity, flowing through virtually vacuum-tight openings and up the side of a containing vessel in apparent defiance of gravity. All of these effects may be explained by the presence in He II of a superfluid. The atoms of the superfluid have had their energies reduced by cooling to the point where thermal motion has almost ceased, yet the intermolecular forces are not great enough to produce a rigid solid.

Through use of liquid helium produced in the new Simon-type liquefier, a project is now well under way at the Bureau for the study of various aspects of second-sound propagation in He II. Unlike ordinary sound, second sound is generated thermally and can be detected only by temperature-sensitive devices. The present work employs a recently developed pulse method. Pulses of heat generated electrically travel through the liquid He II, are detected upon arrival at a temperature-sensitive element, and are presented on an oscilloscope screen for visual observation. Meanwhile, their transit time is measured accurately by electronic timing circuits. Several quantities, including the velocity and attenuation of second sound, result directly from these data. Investigation of the properties of liquid He II provides a promising approach to the study of the properties of matter, especially the liquid and solid states.

X-RAY MEASUREMENT OF STRAIN IN METAL.

Detection of fatigue damage in metals before fracture occurs is the primary aim of an improved technique developed at the National Bureau of Standards for X-ray measurements of strain in metals. Calibration curves for the method also indicate increased sensitivity and precision.

Fatigue is the term used to denote progressive fracture of metals under the action of fluctuating stress. The magnitude of the fluctuating stress that will eventually cause fracture is much smaller than that required under static conditions, and as a result fatigue is a primary cause of failure in machine elements. The course of fatigue fracture can be divided into two stages: (1) the metal undergoes some sort of deterioration or damage that finally results in formation of a very small crack; and (2) the crack grows until the member is weakened to such an extent that it fractures suddenly. No reliable method has previously been known for evaluation of the damage that takes place during the first stage except through a fatigue test. The present work was initiated because it would be extremely valuable to have a nondestructive method for measuring this damage.

The fact that a crystal deforms under the influence of an applied stress and that the resultant change in its interatomic spacing can be measured by X-ray diffraction has for many years been utilized in the determination of strain and stress in metals. Although the method possesses many advantages, certain unresolved difficulties, principally its lack of sensitivity, have limited its usefulness in certain applications. One application of this type is the study of fatigue damage.

The X-ray method of determining strain involves measuring the change in diameter of the diffraction ring from the specimen. In the case of metals this ring is inherently quite diffuse because of imperfections in the metal crystal. It is therefore impossible to obtain exact values for the ring radius. As there did not appear to be any experimental method that would significantly improve the accuracy of a single measurement, it was decided to increase the precision by making a number of measurements of ring radius. For each stress condition, therefore, two diffraction patterns were taken at different angles of incidence, and twelve measurements of radius (at 30° intervals around the ring) were made on each pattern.

In addition, special methods were devised for handling the data, to give a single value representative of the twelve radius measurements, because the diffraction ring of a stressed specimen is not exactly circular. These methods, which were used where averaging the measurements would have resulted in a loss of sensitivity, are valid only for uniaxial stress in the surface of the specimen.

For calibration, observations were made on a flat steel specimen

loaded in bending to produce a tensile stress in the surface under examination. Actual strain in the surface of the specimen was measured with wire strain gages placed above and below the spot that was irradiated with X-rays. Diffraction patterns were then taken with the beam normal to the surface and with 45° incidence. Plotting values obtained from these patterns against surface strain yields characteristic curves. Besides providing a calibration for the method, these curves reveal significant behavior of the metal under strain.

HIGH-TEMPERATURE CERAMIC COATINGS FOR MOLYBDENUM.

Ceramic coatings designed in National Bureau of Standards laboratories specifically for the protection of molybdenum at very high temperatures have successfully resisted temperatures of 3000° F. and higher in laboratory tests. At the same time these coatings have retarded oxidation of the metal for short periods of time, in some cases as much as 45 minutes. Temperatures in this range are encountered in the gas streams of ram-jets, pulse-jets, turbo-jets, and rockets. The materials that are currently available for these power plants, however, do not possess the necessary properties for maximum performance at such temperatures.

Of the metals that have melting points above 3000° F., only such scarce metals as platinum and iridium have sufficient resistance to oxidation to be used without protection. Obviously their use is impractical. Other metals with high melting points, but lacking adequate resistance to oxidation, include titanium, thorium, zirconium, boron, molybdenum, tantalum, and tungsten. Although the last three (melting at 4750, 5160, and 6100° F., respectively) are of especial interest for very high-temperature applications, only molybdenum is available in very substantial quantities. The exploratory work on protective ceramic coatings that would permit metals of this type to be used at high temperatures in oxygen-bearing atmospheres was therefore done with molybdenum.

Coated specimens were subjected to several significant performance tests during the investigation. These included heating in a gas-oxygen flame, heating at constant temperature in an air atmosphere, and service testing in the blast of ram-jet engines. Oxidation of the molybdenum was greatly retarded by the best of the ceramic coatings. In an air atmosphere at 1650° F., unprotected molybdenum sheet was found to decrease 0.02 in. in thickness in ½ hr. There was no decrease, however, for ceramic-coated molybdenum heated for 70 hours under the same conditions. At a gas temperature approximating 3500° F., giving a surface temperature on the specimen of 2600° F., or more, only short-time protection of the molybdenum was attained. The oxidation rate was sufficiently retarded, however, to make the use of coated molyb-

denum feasible for special applications in which prolonged service is not required.

An immediate application is the protection of molybdenum Pitot tubes that are built into the nozzle end of ram-jet engines used for pilotless aircraft. These tubes are expendable and need not last over 5 minutes. A simulated service test of a ceramic-coated tube indicated a life in excess of 45 minutes. Other examples of equipment in which even short-time protection can be valuable include coated thermocouples and resistance thermometers made of high-melting-point metals.

Further research is being directed toward coatings which will have greater durability, and which can therefore be used for high-temperature applications where longer service life is required.

NOTES FROM THE BIOCHEMICAL RESEARCH FOUNDATION.

Choice of Research Projects.—ELLICE MCDONALD, Director. Every organization has different aims and the direction is influenced by the purpose for which it has been begun. For example, chemical research naturally has to do with the production, adaptation and development for use of chemical substances. If the purpose lies in one phase of science, the organization is fortunate, for there are then fewer variables to consider. Physics may be taken as another example where it was but little taken over to aid in other branches of science. It is only now beginning to be drawn over into other areas to illuminate special fields of investigation.

An attempt has been made to classify branches of science as to basic or otherwise. Not knowing exactly what "basic" means in this connection, it seems better to use the term exact or fundamental for, after all, the division between the branches of science depends upon the possibility of quantitative measurements and the accumulation of measured facts capable of confirmation. And after all, all phases of science are one in that they are the expression of the nature and reactions of matter: they depend upon the forces of nature and the totality of its laws.

Life is a chemical phenomenon and all chemical processes consist of the giving, taking and sharing of electrons. Vital processes are those of oxidation and reduction which consist of giving and taking of electrons. So life in its broad sense is electron transfer. So vital processes, chemistry, physics, all come together.

Biochemistry and biology are not so fortunate as to be able to explain the mechanism of the action of the forces it studied. Life is still a mystery, both to the anamists and the mechanists. Everywhere in biochemistry, we come finally up against the profound mystery of life itself. For this reason there are many unknown variables and few criteria of accuracy. So biochemistry must involve many other phases of science, chemistry, physics, and cytology with all their ramifications. For this reason, the choice of research projects is difficult.

Like riches, some inherit research projects, some achieve research projects and some have research projects thrust upon them. In some organizations the avenues of adventure to follow are more or less well defined. In the great new automobile research center which Kettering has designed, the research will be to make better automobiles; and the motor car with some understanding of its mechanism is there to start with so that it is possible to plan research into improvements on an exact basis, better design, better motive power, better moving parts,

always with the hope that some illuminating factor will evolve outside all plans but resulting from the atmosphere of research and the stimulation of the imagination.

This limits the problems a bit, although it is sure that Kettering would not agree to this statement; but in chemical research laboratories there seems to be a wide scope as to what may be possible, so that the line to be followed cannot be so well defined. The great discoveries of chemistry and the enormous possibilities of future discovery of things useful to mankind stagger the imagination. The field is so large that the area upon which to work must be difficult to decide.

Biochemical research projects, therefore, must be more carefully chosen and scrutinized. The unbelievable advances of the last half century seem to offer almost boundless possibility. The human mind is inclined toward doubt and scepticism and toward an inherent fear of change which may upset things as they are. This seems to be the origin of doubt as to future discovery which is the unfolding of new things. Discovery is always a surprise and its form cannot be really anticipated. All we know is that discovery will occur and that it is more likely to occur at the present time than at any other period in the past.

The amount of past discovery makes more future discoveries so probable as to be almost a certainty. The curve of research success is still upwards and at a sharp angle, so that it would require a catastrophe to stop its upward slant. We cannot anticipate what form it will take: we can only surmise the phase in which it will appear. But who could have anticipated radio, television, the internal combustion engine: things that are taken as commonplace now. All we know is that based upon past accumulated and recorded experience, new discoveries will come.

What an adventure is this to the next generation. They will live in an atmosphere of intellectual stimulation which should energize them more than anything that has gone before and give them a continual uplift of spirit so that they will pass their lives in a glow of imagination and in a great sphere of activity.

But for the present, research projects must be chosen in relation to the present state of past discoveries. The advice of a professor at Massachusetts Institute of Technology to some of his students who asked advice as to their future course in life was, "First do what you want to do; if you can't do that do what you can; if you can't do the latter, try to make money." If "make money" is paraphrased into "do research along classical lines, follow and develop recognized procedures and confirm and extend known experiments," this advice will hold good for the selection of research projects.

The choice of research projects should be made carefully and with great deliberation after canvassing all phases of the subject. It should be remembered that an organization where the director originates all

the research projects is one where the general individuality and scientific imagination are low. Most research projects should be suggested by the personnel, but the one who suggests a fine new research project is often taken aback by the lack of enthusiasm with which it is considered. This director has experienced many instances where an enthusiastic research worker has felt hurt when his suggested research project was received and discussed with such caution and deliberation.

It is easy to get involved in a research project and hard to stop one. When involved it usually elaborates to greater expansion in time, personnel, occupation of equipment and in dollar cost because someone must pay for the show. Then too, should be considered the loss of other research, still undone but possible and which may come up for consideration and which could be crowded out of the place in the organization occupied by the research project under discussion. In other words, is the research project under discussion of sufficient importance to occupy not only the present place in the research, but also of sufficient importance to displace another project not yet considered, but which may be of greater importance than the current one.

To discontinue a research project is difficult, for the forces and materials have been arranged and assembled and demobilization means that the research project is failing or perhaps that something more important has intervened. To solve the problem in a research project is not easy. If it were, someone else would have done it: it takes time and effort. Biochemical research projects in general require at least three years and may run to more. The extensions and ramifications of a problem may enlarge the whole subject until the amount of personnel, time, and cost of the original suggestion are much increased. So that before there is any commitment there should be due deliberation and discussion.

A research project may be stopped or it may be allowed to die a natural death. In the last analysis the director must decide when to stop a research project that has no hope of fulfilment or which will be too long term or for whatever other reason there is for not going forward. One trouble in discontinuing a research project is the effect it sometimes has on those absorbed in its execution: men who are completely occupied in one train of thought are often repulsed and indeed sometimes shocked when asked to relinquish a problem which has little chance of success. It does not mean that they are so regimented that they must unlearn all that they have done and acquire new techniques, but that they will apply their talents and training to a new subject where there is more chance of success. They have been thinking and meditating along certain lines and to ask them to cease to do so and to consider other matters is a difficult matter. For this reason a director is apt to be slow in diverting the thought in a new way and is inclined to lead up to it very gradually. Sometimes the workers will ask for a certain time to

continue further work on their research project before abandoning it and if this is weakness on the part of the director or not, he usually gives it. By putting himself in the place of the men doing the work, he can ask himself how he would like it if he were in their position. And after all, the Golden Rule is a good motto for any director to follow. A research project sometimes will die of itself and that is a much happier condition for then everyone is satisfied that there need be no continuance of that particular plan.

We have established in our research a *schema* for consideration of every suggested research project and as a matter of fact, these are printed on cards and given to everyone in the organization.

PROJECT POSTULATES.

1. Experiments to determine the existence of some effect.
2. To measure it.
3. Consider the significance of the effect.
4. The magnitude of the significance.

To this was added the following elaboration:

What are we studying and why?
If we get it, what will it be worth?
Will it lead to more?
How long and how much trouble will it take?
Will it develop new areas?
Is it useful?
Is it within our capacity?
Will it involve those working on other useful projects?
If it is to be abandoned, how can that be done without loss?

A careful scrutiny of a research project according to these postulates saves a lot of grief in the long run. To take them seriatim—*to determine some effect*—is the crux of the matter. Sometimes experiments are done just because they can be done without consideration as to whether there is a real rationale in the matter or not. The real criterion of a research project is discovery and that must produce some effect; not effect in the sense of power or action; but effect in adding to the sum of knowledge in expanding new fields, improving older methods or explaining mechanism.

To measure it, this is easier in the areas of chemistry and physics than it is in biochemistry. In the more exact sciences measurement is not so hard because they have to do in chemistry with pure and known materials and measurable rates of reactions, exact end points and reaction yields which can be weighed. In physics the tools for measurement are more exact than in any other phase of science.

In biochemistry, on account of the large number of variables and unknown mixed materials, exact measurement is difficult unless the

experiment can be geared to some phase of physics and chemistry to make use of their methods. An example is in the Warburg-Dixon-Keilin manometer technique where chemical reactions with end points can be made an index of respirative oxidation-reduction and action in various enzymes and in study of thin slices of living matter. For enzyme study, these methods are of great value, but the individual technique must be usually worked out for each research project. Another example is the Tiselius electrophoretic apparatus which makes use of methods of physics for the study of the distribution and amounts of the various proteins existing in blood serum and other biological fractions. These proteins have a different distribution in almost every disease so that the method, while relatively new, gives promise of being of great value in medicine.

Quantitative measurement is an essential in the modern experimental method because exactitude of results gives opportunity for further exploration, develops new fields and makes confirmation possible when the conditions of the experiment are laid down.

To consider the significance of the effect, if achieved, is to get an idea of its real value and its relation to other known facts in the same field. The significance is sometimes not to be appreciated at first and other known discoveries often throw a light upon the real importance of the experiments.

The magnitude of the significance is a measure of the importance of the research. There may be a continuation of very fine experimentation with a definite result which will have but little value in the perspective of the total picture. If it is probable that the significance will be slight, the research project, before its adoption, should be deliberated with great caution: the mountain in labor may produce a mouse. A research aggregation is a valuable tool and those responsible have a duty to see that its uses are not dissipated in little things.

What are we studying and why may seem tautological and to have been covered by consideration of the research project itself, but such deliberation and caution in the choice of a project is necessary so that it does not harm to clarify the conference's mind and re-discuss all ramifications.

If we get it what will it be worth is in the same category but stated a little more elaborately in order to have a concise idea of the aim of the effort. Of course, it is not always possible to determine the worth and associations of a research project any more than it is to be sure that experimentation will be successful. It is all an adventure into the unknown, but based on some previous information. The value of a series of experiments may sometimes be much greater than at first imagined due to collateral experimental results of others and even of other phases of science.

How long and how much trouble will it take is something that must be

weighed against the worthwhile estimate of the subject. A long-time research project is more difficult to define and to plan the course on account of the ramifications which may eventuate. Long-time research projects are apt to have enthusiasm slacken and it is more difficult to keep the attention directed to them. They are apt to become perfunctory. In their course new ideas come up and the long-time research project is looked at askance as being in the way. Surveying the past, few long-time research projects have been successful.

It is of course difficult to determine ahead of time how long a research project will take, but like an Arctic exploration which lays down the probable time of its return and, before it starts, makes preparation for a relief expedition to be dispatched if it is long overdue. Also nowadays there have been so many rescuing Arctic expeditions, that the Canadian Government will not allow any to start unless these are well equipped and with experienced explorers who are not likely to get lost or require rescue. The same holds for long-time research. If the proper research men and apparatus are not available, the research project is likely to get bogged down and require rescue.

Will it develop new areas, that research project is a poor one if it will not do so. There should be a general direction in a research and all research projects are usually more or less directed toward that, so that most research projects will open part of the field to throw more vision upon the rest.

Is it within our capacity cannot be estimated without some past experience of a somewhat similar nature. It is no use adopting an ambitious program if it cannot be carried out. The capacity will often depend upon specialized apparatus and men skilled in their use: it will depend on specialists in one or other phase of science: it will depend upon these being given the time, place and lack of interruption necessary to the proper accomplishment of the task: it will depend upon the amount of total program in the laboratory so that the new research project will not crowd it: it will depend on competition with other research projects and possible new research projects for its space in the total program.

Will it involve those working on other useful projects is a most important matter and it is difficult to take a man or a group who are occupied in a certain problem and ask them to do part of a new research project. Care should be taken that both do not suffer or that one, either the old or the new, will not suffer from neglect: this is a matter of directorship as so many things are in the choice and management of research projects.

If it is to be abandoned, how can that be done without loss sounds like defeatism, but it is a wise general who, no matter how strong his offensive, still makes plans for retreat and withdrawal. It is not well to stress this to the group involved in the research project; but the director must think of this ahead of time, or otherwise, if the research project fails, like a battle, there may be a *debacle* and the whole group be dis-

heartened and disorganized until new plans are made. But in the beginning failure should not be discussed: the group should be encouraged to go forward as if victory were certain. If too many qualifying circumstances are brought up, resolution fails: its "native hue is sicklied o'er with the pale cast of thought." As Napoleon said in criticizing General Angereau, "He sees too many things," meaning that he was oppressed by obstacles and saw lions in the path.

One important thing in research projects is to have the tools at hand. Often a research project is planned around a piece of apparatus, but apparatus is of no use without the skilled people to manage them. A good shop is essential, for it seems more and more that every problem needs new apparatus made or other apparatus modified to suit the research project and this must be done either by the men themselves or by the instrument makers. Mostly this has to do with metal work as the supply houses have perfected glass apparatus to such a degree that little glass blowing is required.

There is a word, *serendipity*, which was coined by Horace Walpole in 1854 and this in a skit he gave the meaning as "making discoveries by accident or segacity of things which they were not in quest of." The dictionary defines it as "the faculty of making happy discoveries by accident." While on a holiday in Cuba in 1938, I found this word in a detective story by S. S. Van Dine and quoted it in my annual report (JOURNAL OF THE FRANKLIN INSTITUTE, Jan. 1939). It seems so pertinent to the vagaries of research that many have used the word since. In fact, Cannon in his scientific autobiography ("The way of an investigator," Norton, 1945) devotes a whole chapter to it.

Many such discoveries have been recorded and often the earliest steps are mostly due to accident taken advantage of by the observant mind. Pasteur started out to find why certain crystals were lop-sided and ended by discovering that bacteria cause disease. Koch discovered how to separate microbes in a mixed culture through half a potato left on his laboratory bench. Penicillin was a chance observation. Galvani noticed that dead frogs hung on a copper hook twitched when they touched the balcony where they were hung and so discovered the galvanic current, followed by the voltaic pile, forerunner of the storage battery. Iodine was accidentally discovered by Courtois in 1811 in the mother liquor of kelp. The cyanide industry of great value in Germany resulted from the accidental discovery of prussian blue by Diesbach early in the eighteenth century. The most useful gas, acetylene, was discovered by accident. Roentgen discovered X-rays by accident although many other experimenters had as good an opportunity. The list may be continued at length, but these are some examples.

The deduction may be made that discoveries are only made by accident, but that does not take into account the great number made by design. Still all workers should be on the outlook for leads, ex-

traneous to the problem which may indeed be more important than the research project itself. Still chance happens to the prepared mind and constant rumination of the problem brings new aspects and new perspectives. The quality of never letting exceptions pass unnoticed should be cultivated. Often a by-product of the planned series of experimentation becomes more important than the original project. All concerned in a planned project should be on the outlook for valuable side observations which may either be developed coincidently or made the basis of a new series of experimentation.

In all research projects, if possible, there should be an alternative of objective: if the main line of attack is not successful, another should be considered. A plan with a single aim is like a barren pole. A research project is like a military campaign and, as Napoleon said to Gourgaud, "the great art is to change during the action the line of operations: it is an idea of mine which is entirely new." It may have been new to him but it was unjust to Bourcet, who fifty years earlier, laid down the principle that "every plan of campaign ought to have several branches and to have been so thought out that one or other of the branches cannot fail of success." The same holds for alternative objectives in the choice of projects.

The statistical project, which depends upon an accumulation of facts, done over and over under the same conditions and then a census taken to determine the result, is a type of experiment-and-error research. It is usually done when there are not enough quantitative measures or too many variables to apply the quantitative method. It is a type often used in medical research. It is fraught with possibilities of error and takes a long time and a great deal of trouble to collect and analyze the data. It does nothing to explain mechanism and seldom opens new fields of further experimentation. It is a type of project to be chosen when no other is available.

New discoveries will sometimes interfere with research projects and make them obsolete. Such a case was our carefully planned and partly fulfilled large study into vaccines for pneumonia which were then very much needed. Sulfanilamide was re-discovered and its use in pneumonia brought down the mortality of pneumonia from 20.8 per cent to 3.9 per cent. Vaccines are now only occasionally needed. Such an event brings mixed feeling: joy that a discovery is made and regret for the lost time and effort. On the other hand, the resistance to scientific novelties is due to an intuitive, if unconscious, appreciation of their revolutionary nature. The slightest and the most innocent scientific innovation is but a wedge which is bound to penetrate deeper and deeper and the advance of which will soon be impossible to resist. Conservative people are undoubtedly right in their distrust and hatred of science, for the scientific spirit is the very spirit of innovation and adventure—the most reckless kind of adventure into the unknown.

The general basis for the choice of research projects cannot always be followed because some research projects are mandatory and must be done. But this is no reason why they should not be closely scrutinized. The old wheeze of the man who searched diligently on Piccadilly for a shilling he had lost on Regent street on the ground that there was more light to see by in the former place, is not so funny as it sounds when thinking of research projects.

Research projects are much more numerous nowadays: twenty years ago, at least in biochemistry, research projects had to be searched for: now the question is to choose the best from many. This appears to be due to the greater advances in technique and the better tools available. During the war years, research was difficult because all were intent on defense projects. Then too, research men and young men who could be trained were inducted into the armed forces owing to the short sighted policy of the Government which has not only destroyed organizations but put the younger ones capable of training into jobs far removed from their aptitudes. The Biochemical Research Foundation lost two-thirds of its personnel to the armed forces and other defense work: not one of these has been put to work on research. Not only will there be a lost generation of young research workers but the older ones taken from their research atmosphere will have difficulty in orienting themselves again.

Research projects are experiments directed by the disciplined imagination of a group of individuals of varied mental outlook and diverse training who are able to transcend the results obtained by the isolated scientists save for the exceptional geniuses. Commonplace qualities well trained, well proportioned and consistently well displayed will in organized groups give consistently better success than any individual effort. Upon proper choice of research projects depends the success of the research.

BOOK REVIEWS.

PRACTICAL TELEVISION SERVICING, by J. R. Johnson and J. H. Newitt. 334 pp., 16 × 24 cm., illustrations. New York, Murray Hill Books, 1949. Price, $4.00.

Here is a new book on practical television with particular emphasis on efficient trouble-shooting techniques. Mr. Johnson was formerly Managing Editor of *Radio Maintenance Magazine* and Mr. Newitt was formerly Project Engineer with the Federal Telecommunications Laboratory. At present they are the operators of a modern television service organization.

The book is primarily intended for the radio serviceman and student who wishes to enter the field of television servicing. The authors, having had several years of experience as television teachers, have presented the material in a very logical and straightforward manner. They do not attempt to go into the fine details of television theory with the accompanying complicated mathematical formulae. This book is not for the engineer or designer, but for the man in the field who must keep the set operating.

The first few chapters comprise a review of the fundamentals of radio receivers, comparing these with the basic television system. Considerable time is spent on the various stages of the television set including the r-f stage, the mixer, the i-f section, the detector, video amplifiers, cathode ray tubes, and the synchronizing circuits. Throughout the text, particular emphasis is placed on the servicing problems involved in all of these stages. At the end of each chapter the authors have included problems for the students to consider.

The remainder of the book contains a wealth of information on modern servicing and installation techniques. Many hints on proper tools and equipment, precautions, and safety measures are also presented. Detailed discussions on antenna installation, wiring techniques, and proper replacement components are included. Schematic diagrams of practically all of the commercial television sets on the market are also given in the text. There are many troubleshooting case histories explaining how to spot disorders and localize troubles.

The book will prove an excellent text for both student and practicing television servicemen for its methodical presentation of efficient servicing techniques.

D. M. BIBERMAN.

SCIENTIFIC FOUNDATIONS OF VACUUM TECHNIQUE, by Saul Dushman. 882 pp., 16 × 23 cm., illustrations. New York, John Wiley & Sons, 1949. Price, $15.00.

Shortly after the invention of the incandescent filament electric bulb, it became apparent that means for obtaining a high vacuum would require a great amount of research. The intervening years have seen the growth of vacuum technique as a specialized scientific endeavor, just now emerging from the research laboratory to the engineering stage. With this emergence there now comes, through the efforts of a pioneer in this field, the first really modern treatise on this subject.

Dr. Dushman's many years of research experience in the fields of vacuum technique, gas discharges, cathode devices, vacuum gages, and other activities, are reflected in this book, which approaches the subject matter not only from the experimentalist's point of view, but also from the theoretician's. The latter approach is necessary since an understanding of some fundamental ideas in physics, chemistry and perhaps metallurgy may be useful to scientists and engineers dealing with problems in the production and measurement of high vacua.

Extremely comprehensive in scope, the book describes in detail the many phases of achieving, maintaining, and measuring very low gas pressures, applicable to research laboratory and engineering usage. No sharp line is drawn between the theoretical and practical phases. Each of the twelve chapters in the volume considers the fundamental aspects of the subject for that chapter as well as the application of the theory to the design of equipment.

A first chapter treats of the kinetic theory of gases, developing from basic principles the equation of state of ideal gases, the Maxwell-Boltzman distribution law, mean free paths, and problems of heat conduction and diffusion.

The flow of gases through tubes and orifices is then taken up, with emphasis on viscous, turbulent and "free-molecule" flow and the use of porous diaphragms and exhaust through tubes and orifices.

These two chapters are sufficient introduction to the practical problems in vacuum technique, which are approached first through a chapter devoted to mechanical pumps. The commercially available rotary oil and molecular pumps are described in detail with the aid of numerous charts and operating drawings. Constant-pressure, constant-volume, and circulatory methods for the determination of the intrinsic speed of pumps are described.

The next two chapters investigate "higher" type pumps, those depending upon steam ejection and mercury vapor, and vapor pumps using organic liquids. These pumps incorporate for best operation specially designed nozzles, sketches of the most important types being given.

For the measurement of low pressures there are required different types of gages and manometers which operate according to a variety of physical principles. Numerous ones are described, among which may be mentioned the following basic types: Rayleigh; McLeod; mechanical; viscosity; radiometer; heat conductivity; and ionization gages.

Closing chapters of the book are devoted to the sorption of gases and vapors by solids, active charcoal, silicates and cellulose; gases and metals; gases and electrical clean-up of gases at low pressures; vapor pressures and rates of evaporation; and the dissociation pressures of oxides, hydrides, and nitrides.

Many papers are referred to throughout the book, with detailed reference to the original works, in some cases sketches and text material being abstracted therefrom. This adds much to the value of the present book, especially since the author has been so successful in thoroughly scanning the field and has used only really worthwhile references.

The encyclopedic nature of the book, as noted in the subject matter described above, should appeal not only to the specialist in vacuum technique, but also to the general scientist who may be uninformed and wishes to obtain authoritative information on one of the industrially important modern sciences. As such it will be a good reference book, constantly to be referred to, by physicists, chemists, mechanical, electrical and chemical engineers who are most interested in research applications.

S. CHARP.

INTRODUCTION TO ATOMIC PHYSICS, by Otto Oldenberg. 373 pp., 16 × 24 cm., illustrations. New York, McGraw-Hill Book Co., 1949. Price, $5.00.

The atomic bomb and the attendant furor following its use have focused attention on that particular phase of the subject of atomic physics dealing with the nuclear fission of certain rare isotopes by fast neutrons to obtain explosions of extreme suddenness and severity. That there are many other uses for atomic energy and radioactivity are apparent from a study of the subject book, and fortunately, these suggest many possible applications for the betterment of mankind rather than his destruction.

The student of this work is presumed to have an elementary knowledge of both physics and chemistry. From these fundamentals, the presentation of each phase of the subject is made in such a clear manner that understanding is assured. Advanced mathematical treatment is seldom used and then only when needed to demonstrate the ability of the theory to account for observations. The pre-calculus level of this book is entirely satisfactory for establishing the facts of the theory of atomic structure in relation to observed phenomena. Emphasis is placed on the fact that nobody has ever seen an atom, yet the theories can describe it and its component parts accurately and predict their behavior.

The subject as a whole is divided into seven parts dealing with the structural phases of atomic physics. These include the chemical structure of matter, behavior of gases, the structure of electricity and light, the electronic arrangements, the composition and behavior of the nucleus and the wave theory.

Engineers and professional men of all kinds, as well as students of physics, will find this book a substantial introduction to the new atomic age in which familiarity with atomic energy will become a necessity.

F. R. SIMPSON.

FREQUENCY MODULATION, by Nathan Marchand. 409 pp., 16 × 23 cm., illustrations. New York, Murray Hill Books, 1948. Price, $5.00.

Frequency Modulation is a book written for the student, the radio amateur, the serviceman, and the designer.

The author has done an excellent job of presenting a difficult subject in easily understood terms. His theory development and explanation, in addition to being clear and concise, are very well illustrated by numerous diagrams and circuits. Although the author tends to avoid a purely mathematical approach, the book does not suffer as a result. For those who desire to investigate the mathematics of frequency modulation, or, for that matter, any other phase of the subject, more thoroughly, the extensive bibliographical references found throughout the book will prove most useful.

Frequency Modulation covers the fundamental concepts of frequency modulation, numerous methods of generating frequency and phase modulated signals, methods of detection, limiting and other auxiliary circuits, and the servicing of f.m. equipment.

For the reader interested in servicing, many circuit diagrams of equipment in current use are presented. The diagrams contained in the book are also so detailed as to be useful to the radio amateur or experimenter.

The book is well recommended as a very practical treatise on the entire subject of frequency modulation.

R. S. GRUBMEYER.

A HUNDRED YEARS OF CHEMISTRY, by Alexander Findlay. 318 pp., 14 × 22 cm. New York, The Macmillan Co.; London, Gerald Duckworth & Co., Ltd., 1948. Price, $4.50.

The history of chemistry over the past one hundred years is carefully recounted here in the second edition of a most interestingly written book. The rapid development of modern chemistry from the time of Leibig and Wöhler (1830's) has direct bearing upon the advances of mankind in many related fields, and these are considered briefly as the story of chemical science unfolds.

Scientific thought, especially in chemical science, has in the past progressed in a most non-uniform rate, even over the past century. Periods of intensive effort in the various phases of chemistry have been followed by periods of non-activity. Furthermore, in this same 100-year period, there have been numerous shifts in emphasis in the major fields of chemical endeavor.

This work is not a mere recounting of the construction of the edifice of chemical science. The author, an Emeritus Professor of Chemistry at the University of Aberdeen, has established a definite aim for his work. It traces in broad outline the story of how chemists have studied the properties and transformations of matter and the laws which describe how these transformations take place. The synthesis of compounds in the laboratory in accordance with the knowledge of the inner structure of the atom and molecule is in some respects the ultimate use of the chemists' knowledge of the fundamental nature of matter. Upon this is based the entire field of industrial chemistry, with its broad implications in the advancement of industry and the well-being of mankind.

The thirteen chapters in this book, while by no means exhaustive in nature, bring to the reader the highlights of discoveries and their relationships to one another. A chapter devoted to historical background reaching even prior to the first quarter of the nineteenth century serves as a fitting introduction. The works of Boyle, Lavoisier, Faraday, and Gay-Lussac are examined for their contribution to present day chemistry. There follow chapters devoted to the rise and development of physical chemistry and organic chemistry, and the determination of atomic weights and the classification of the elements. As the chemist devoted to pure research made discoveries, applications to industrial use were readily made. The fine-chemicals industry grew, and with it came more discoveries, this time from the laboratories of the industrial chemists, now applying their knowledge not only to industrial chemicals, but also to the constitution and synthesis of many naturally-occurring compounds which are most familiar to us today.

The past ten years, the period of time between the first and second editions of the book,

have seen major developments in the atomic and nuclear fields of chemical physics. Great advances have been made in the domains of radioactivity and the rare gases, the chemistry of nutrition, and the combatting of disease. The chapters devoted to these subjects conclude the survey of developments in the past century.

The nature of the subject matter, being essentially historical, should appeal to many workers in the physical sciences, primarily to serve as a source of thought in the growth of a most important field of scientific endeavor.

S. CHARP.

INDUSTRIAL ELECTRONICS AND CONTROL, by R. G. Kloeffler. 478 pp., 16 × 24 cm., illustrations. New York, John Wiley & Sons, 1949. Price, $5.50.

Professor Kloeffler, who is Head of the Electrical Engineering Department at Kansas State College, has prepared a very practical text on this fascinating and very important subject. The book treats those aspects of electronics and control that lie outside the field of communications. It is primarily intended as a text on the theory and applications of electronics in industry and is designed to meet the requirements of the electrical power major and also of mechanical and chemical engineering students desiring a knowledge of this subject.

The first few chapters of the book serve as an introduction to the basic theory of electron tubes. The treatment here is very lucid and is primarily for those students who have no previous knowledge of electronics. Professor Kloeffler then develops the theory into associated circuits and finally control component devices.

The remainder of the book covers practically all of the major applications of electronics in the industrial field. Here the author devotes entire chapters to a detailed discussion of the various techniques involved. Included in this section of the book are chapters on the principles of servomechanisms, rectification and inversion, high-frequency heating, resistance welding, electrostatic precipitation, electronic control of motors, photoelectric control devices, electronic regulators, amplidyne servomechanisms, X-ray application, and others.

The treatment of the subject matter is thorough and understandable. No attempt is made to provide a quantitative approach to the design of circuits since the book is meant to be only an introductory text. The only prerequisite for a complete understanding of all the material is a knowledge of physics.

Throughout the book the author has included problems for the student to consider. It is abundantly illustrated; and since Professor Kloeffler's style of writing is straightforward, the book is easy and pleasant to read.

D. M. BIBERMAN.

ELECTRICIANS' POCKET COMPANION, by B. Goldberg. 442 pp., 13 × 20 cm., illustrations. New York, Murray Hill Books, 1948. Price, $2.50.

This is essentially a reference book. It contains a large variety of information in the form of tables, lists, diagrams and some text material. Much of the information in the tables and lists is useful to the handyman. Wire, drill, nail, screw and bolt sizes are examples of such lists.

The handbook contains a dictionary of commonly used electrical terms. This is valuable to the person who is just becoming acquainted with the electrical field. Most of the definitions are clear and concise. However, definitions of such scientific terms as "Oersted, a unit of magnetic reluctance" probably will leave the non-technical reader in a frustrated mood.

The book is written on a very elementary level. It contains a short description of common tools and their use. Some of the tools are peculiar to the electrical trade but most of them are familiar to the high school boy. The check list of commonly used apparatus and materials is also intended for the elementary student. Certainly the competent electrician should know these things without referring to a handbook.

The section on "Methods of Work" is a detailed description of many of the basic mechanical and electrical procedures used when wiring a building. This section in combination with those on motor, meter, lighting and heating circuits will prove of interest to the handyman.

He will be interested in the section on residence wiring which outlines the electrical wiring requirements for the modern house.

Symbols, abbreviations, formulas and examples and nearly a hundred other tables and lists make the book useful. But since it is primarily a reference book, explicit instructions for planning and executing the wiring for a building are not given.

The book will be useful for the high school student and as a reference work for the neophyte electrician.

E. A. MECHLER.

MECHANICAL VIBRATIONS, by William Tyrrell Thomson. 222 pp., 14 × 22 cm., drawings and tables. New York, Prentice-Hall, Inc., 1948. Price, $5.00.

The book is especially designed for students who desire an elementary text on mechanical vibrations. It presupposes a slight knowledge of calculus, dynamics, and strength of materials. It is written primarily for class instruction and follows closely the material presented in the course in mechanical vibrations offered to senior and graduate students at the University of Wisconsin. The chapter headings are: (1) Introduction, (2) Undamped Free Vibration-Single Degree of Freedom, (3) Damped Free Vibration-Single Degree of Freedom, (4) Forced Vibration-Single Degree of Freedom, (5) Systems with Two Degrees of Freedom, (6) Systems with Many Degrees of Freedom, (7) Vibration of Elastic Bodies, (8) Electromechanical Systems and Analogies.

The last chapter presents the analogy between mechanical and electrical systems. It contains a table of analogous quantities and equivalent circuits for many mechanical systems. With the exception of the last, the chapters are among those usually treated in mechanical vibration texts.

The book's elementary nature together with its extreme brevity for a book of this type (222 pages) necessarily results in the exclusion of some topics and lack of rigor in the treatment of others. There are several minor mistakes and teachers using the text may desire to supplement it with outside material.

D. B. HOUGHTON.

ANNUAL REPORTS ON THE PROGRESS OF CHEMISTRY FOR 1947, issued by the Chemical Society. Vol. 44. 327 pp., 13 × 21 cm. London, The Chemical Society, 1948. Price, $5.00.

This present volume of an important chemical review series brings together sixteen papers on a diversity of topics. Among the longer papers is one dealing with the organic compounds of fluorine, by F. Smith. Covering a field which has seen an unusual expansion during the last seven or eight years, this paper records many new developments. Fluorocarbons, heterocyclic fluoro-compounds and the properties of fluorocarbons are discussed first. More interesting from the point of view of the study of organic reactions are the partly fluorinated compounds. Six methods of production are discussed as well as the properties of these compounds. Two final sections discuss fluoro-olefins and perfluoro-acids and their derivatives. The author's concluding statement might be noted as an indication of some of the possibilities in this field, "Now, with methods for the preparation of perfluoro-compounds having the usual functional groups, it is believed that combined physical and chemical investigations will provide a better insight into the electronic interpretation of organic reactions, so that for a particular reaction one electronic mechanism may be given instead of several tentative ones."

Another interesting paper is offered by E. C. Wood on the application of statistics to chemical analysis. The author emphasizes the need of consulting the statistician before rather than after the experiment and reviews how various statistical techniques may be used to advantage in chemical analysis.

The other papers will have their particular appeal and the volume maintains the usefulness of this series for reviews of significant developments in chemistry.

G. E. PETTENGILL.

MICROWAVE TRANSMISSION CIRCUITS, edited by George L. Ragan. 725 pp., 15 × 23 cm., drawings and photographs. New York, McGraw-Hill Book Co., Inc., 1948. Price, $8.50.

World War II brought about the first widespread utilization of microwaves for practical purposes. By microwaves we generally mean electrical energy of wavelengths from 12 to 1.2 cm. corresponding to frequencies of 2500 to 25,000 megacycles per second. It was the use of this radiation that made precision radar possible.

After initiation by the British the tremendous task of developing microwave apparatus was left to the laboratories in the United States and to the engineers of many concerns engaged in manufacturing. By the end of 1945 sufficient theory had been developed and sufficient empirical data had been collected to make possible the manufacture of microwave transmission equipment for almost any application. In fact, a quantity of components was available on the American market comparable to the variety produced for any other communications circuits. Likewise, a complete line of measuring instruments and test equipment was being manufactured.

Prior to 1942 it would have been impossible to purchase or procure by special order any microwave components whatsoever. Therefore, it was during the four years, 1942 to 1945, that all of the research and development work necessary to achieve the practical utility of this field of electricity was carried on.

Evaluated on a basis of man hours of research time the bulk of microwave development was centered at the M. I. T. Radiation Laboratory. Contributions to the subject were made available from four sources. Physicists such as N. H. Frank, J. C. Slater and L. J. Chu provided theoretical treatments. Components groups in the Laboratory devoted exclusively to the development of particular items, for example, T-R boxes, contributed volumes of measured data. Systems engineers provided practical designs for use in radar equipment. A procurement group labored patiently with experimental runs of components subcontracted to outside manufacturers. These activities within the Laboratory provided the basis for a treatise on microwave transmission circuits embodied in Volume 9 of the M. I. T. Radiation Laboratory Series.

Although George L. Ragan acted as editor, there were seven contributing authors comprising key men in this field. The specialties of these men include transmission circuit theory, materials and construction techniques, components such as various types of lines and couplings, rotational joints, tuners, power dividers, switches and microwave filters. The mathematics employed in the book utilizes primarily the concepts of impedance making illustrative use of the admittance diagram or Smith chart.

The book is filled with plotted data on transmission characteristics of waveguides containing various geometrical configurations. The section on microwave filters makes use of familiar communications circuit analysis techniques with the proper adjustments necessary for the treatment of microwave plumbing. This volume contains the essential information for the design of workable equipment and will be found invaluable to the design engineer. It is in no way a textbook for the student, but rather a reference for the specialist.

C. W. HARGENS.

FOUNDATIONS OF MODERN PHYSICS, by T. B. Brown. Second edition, 391 pp., 15 × 23 cm., illustrations. New York, John Wiley & Sons, Inc., 1949. Price, $5.00.

In 1940 Professor Brown wrote a book which presented the fundamental theories of modern physics as they were then known, written from the point of view of experimental physics. The intervening years, however, have seen tremendous practical application of several new theories and applications pertaining to atomic and nuclear particles, with two results: new material was made available for teaching purposes; a renaissance of interest was made apparent on the part of students and the general public. These factors contributed materially to warrant a second edition of this book.

While the book treats experiments as aids in the interpretation of physical principles, there is included a wealth of material of a more fundamental research character.

This second edition follows the same plan as in the earlier work, namely, the reader is not required to know advanced mathematics—only elementary algebra and geometry. This restriction to a non-mathematical approach prevents the development of the general theory of several phases of modern physics, but it does not prevent the author from presenting clear descriptions and explanations so necessary for an experimental and practical approach to modern theories. This he has accomplished remarkably well. As a result, however, the book takes on the form of a survey work, treating of experimental data and the knowledge derived therefrom. To deduce the new "laws" of modern physics requires a good foundation, not only in certain fields of classical physics, but also a sensing of the dependency of the modern theories upon the older parts of physics.

The nineteen chapters and six appendices form more than enough material for a one semester undergraduate course, especially if the text book is supplemented by outside reading assignments and individual laboratory experiments. The material can roughly be divided into four main categories: particles and waves; the dual character of matter and energy; the kinetic theories of atoms and molecules; and nuclear physics and elementary particles.

In the first part consideration is given to the experiments by which we recognize that particles and waves exist separately; that the elementary particles of physics have measurable properties such as mass, volume, and charge; and that waves can be characterized by the familiar quantities of radiation and wavelength. Numerous practical applications which are a consequence of the particle or wave nature of matter are pointed out, such as the X-ray spectrometer, Young's diffraction experiment, and radar and direction finding.

The next section introduces the anomalies which exist with an adherence to either the particle theory or the wave theory of light, that is, it is vividly shown, again through the medium of classical experiments, that there are particle characteristics of waves and wave characteristics of particles. What may be of even greater concern is that there are certain experiments which require the existence of a particle and wave theory simultaneously to explain the observed phenomena. To satisfy the experimental evidence, it is shown that the only safe explanation is light can be both particles and waves. It is in this section that the concepts of quantum physics are introduced, with elementary consideration of atomic structure and spectra and the Bohr theory of the atom.

All the preceding subject matter must be combined with the kinetic theories for atoms and molecules to serve as a background for the last section of the book, devoted to developments in the field of the elementary particles. Consideration is then given to: natural radioactivity; nuclear discoveries; equipment for the generation of high energy particles; considerations of nuclear energies and applications; and cosmic rays. Throughout this last section the author has attempted to keep abreast of latest developments, sections being devoted to the very recent investigations in 1948 on the subject of mesons and meson tracks.

To assist in its use as a text book, the author has included at the close of each chapter a short bibliography of material which in conjunction with the numerous references as page footnotes should be of great aid to the serious student. Problems are also included at the close of each chapter to help the student think out some of the physical aspects of the text material.

S. CHARP.

ATOMIC ENERGY, by Karl K. Darrow. 80 pages, 15 × 22 cm., drawings and photographs. New York, John Wiley & Sons, Inc., 1948. Price, $2.00.

A highly authoritative book by Karl K. Darrow entitled "Atomic Energy" consists of four lectures presented during 1947 at Northwestern University at the invitation of the Norman Wait Harris Foundation. The treatment of atomic energy in this instance was intended primarily for people whose fields of interest were other than physics. The publication results from a provision by the University that the Norman Wait Harris lectures be published.

It is clear that the purpose of this short text is public education in the atomic sciences—a theme which has been stressed many times by responsible scientists during the past three years. In a straightforward and interesting manner but without unreal drama Dr. Darrow explains the concepts of matter and energy based upon atomic particles. A very brief historical review establishes the origin of key discoveries which led to our present knowledge. By the continual

use of simple analogies the author is able to engender an appreciation for the relative sizes of particles and the magnitude of effects.

The author is careful to explain in detail the implications of popular but not generally understood terms such as "atom smashing." By the use of photographs of cloud chamber effects an attempt is made to place atomic theory on a measurable, physical basis.

The last lecture is devoted to description of controlled chain reactions and information similar to that originally released in the Smyth report. These four lectures dealing with historical background, description of atomic and nuclear particles, and introduction to the atomic physicists' techniques and some indication as to how atomic energy is controlled and used provide a respectable elementary understanding of this vital subject.

C. W. HARGENS.

PRACTICAL SPECTROSCOPY, by George R. Harrison, R. C. Lord, and J. R. Loofbourow. 605 pp., 14 × 22 cm., tables, drawings and illustrations. New York, Prentice-Hall, Inc., 1948. Price, $6.65.

Spectroscopy as a research medium dates from 1859 when the spectroscope was first developed as a practical tool for qualitative chemical analysis. Since then there has been tremendous growth in this field of endeavor, but the publication of adequate specialized text books in this restricted research area has not kept pace with the developments of techniques in spectroscopy. The authors of this book, all intimately associated with the Spectroscopy Laboratory of the Massachusetts Institute of Technology, having felt the need for a book to fill an ever widening gap, have written a text book whose subject is the technique of experimental spectroscopy from the point of view of their own research interests, namely: physics, chemistry, and biophysics. An attempt has been made in this text to consider a comprehensive treatment of the subject matter; as a result the book is encyclopedic in character.

The reader is first introduced to this tool early in the book through a description of: the various types of spectra; the general techniques such as emission absorption and fluorescence spectroscopy; and the uses of spectroscopy in many of the physical sciences. The following seven chapters then consider in fine detail various topics which are concerned with: the selection of spectroscopic instruments; prisms, spectroscopes, and diffraction gratings; testing and adjustment of complete equipments; illumination and light sources; and photographic techniques. Each of these subjects is considered from the experimentalist's practical point of view with the net result that the novice in this field can readily make the necessary equipment adjustments, including, for example, certain hints on photographic problems peculiar to the photography of the spectrum.

It was noted above that the spectroscope is widely used in many scientific fields. Still in its infancy is its application to the study and elucidation of band spectra. Much experimental work has been done in attempting to classify the spectrum lines as to their parent atoms. For this purpose special comparators, such as the Judd Lewis, the Hilger, the Sarrel-Ash, and the Harrison Automatic, have been constructed and are described prior to chapters devoted to the origin of atomic and molecular spectra and molecular structure.

The results of photographic spectroscopy are usually based upon a measurement of spectral intensities, the four principal methods—radiometric, photo-electric, photographic, and visual—being described in detail with some commonly used commercially available equipment.

The last third of the book is devoted to certain special techniques. Absorption spectroscopy, the technique of determining the relationship between the wavelength of radiation and its attenuation by absorption upon passage through a particular medium, is considered first. This technique has wide application in organic chemistry, in purification procedures, in the determination of molecular structure, and in qualitative and quantitative analysis, as well as other special uses. Raman, infrared, vacuum ultraviolet, and interferometric spectroscopy are discussed in the closing chapters of the book.

Well studded with footnotes and specific references to the large volume of periodical literature, the reader can investigate in greater detail those problems of his own interest. As to class of readership, this reviewer is of the opinion that the book will become a good laboratory reference text especially for the experimentally inclined student of advanced physics and

others in allied fields of endeavor who may wish to appreciate more fully the power in the research tool of spectroscopy.

S. CHARP.

KLYSTRONS AND MICROWAVE TRIODES, edited by D. R. Hamilton, J. K. Knipp and J. B. H. Kuper. 533 pp., 15 × 23 cm., drawings and photographs. New York, McGraw-Hill Book Co., Inc., 1948. Price, $7.50.

The realization of practical radar during World War II was dependent upon the development of generators of radio frequencies of exceedingly short wavelengths (1 to 10 cm.). The major problem which confronted scientists in this field was that of developing generators of very high power to furnish sufficient transmitted energy. This was solved by the spectacular development of the multicavity magnetron.

However, a secondary problem arose in connection with the receiving apparatus of the radar system where great sensitivity was needed. The practical achievement of this receiver sensitivity required the use of the superheterodyne principle. In order that the intermediate frequency of the superheterodyne be within some reasonable limit, it was necessary to have available a local oscillator which would generate low power also in the 1 to 10-cm. region.

It was fortunate that during the late 1930's the velocity-modulated electron tube, popularly called the klystron, had been invented and developed to a considerable extent. This tube was capable of producing the necessary short waves economically and reliably, and provided the answer to the local oscillator problem in radar receivers.

For several decades prior to World War II engineers had tried to push ever upward the operating frequency of the triode. By constructing the oscillatory circuit as an integral part of the tube it was finally possible to make a device with manufacturable tolerances which would oscillate with low power at 3000 megacycles (wavelength, 10 cm.). This microwave triode tube provided another reliable local oscillator as well as a transmitter for several low power applications.

Volume 7 of the M. I. T. Radiation Laboratory Series describes the fundamental principles upon which the development of these two types of tubes is founded. The authors provide an analysis of the basic electronic phenomena at high frequencies sometimes referred to as electron inertia effects. A thorough mathematical treatment of high frequency space charge devices is given. Much theory and measured data relating the operating properties to electrode potentials are due to the work of many persons in the Radiation Laboratory as well as the Sperry Gyroscope Co., who pressed the development of the klystron, the Bell Telephone Laboratories and the General Electric Co. The reflex klystron is treated at length because it was this type which, owing to its comparative simplicity, was manufactured in quantity and most universally used.

Detailed information on practical tubes is given in tabular form together with some discussion as to the reasons for particular trends in their development. Again, as with the other books of the Series, this volume is one for the specialist, in this case the tube engineer, the radar systems engineer or the communications engineer who wishes to have a thorough mastery of his subject.

C. W. HARGENS.

FEAR, WAR, AND THE BOMB, by P. M. S. Blackett. 244 pp., 14 × 21 cm. New York, McGraw-Hill Book Co., 1949. Price, $3.50.

A work on the application of nuclear energy in war and in peace by anyone so eminent as a Nobel prizewinner in physics is an event in the publishing world. There is no doubt that Professor Blackett as the leading authority on operational research (a method of scientific analysis highly developed in Great Britain for the solution of military problems) is well qualified to speak upon the technical side of the subject. This is not a technical work, however. It deals with highly controversial political aspects of the subject.

Professor Blackett develops two main themes. In the first, he seeks to prove that there is no absolute weapon in warfare. He marshals an imposing array of statistics to prove that strategic bombing, thought by many to be the decisive factor in weakening Germany during the recent war, failed to reduce industrial production and did not materially shake civilian

morale. Not until the end of the war, when the Allies had gained complete mastery in the air, did daylight strategic bombing begin to produce the anticipated results.

In developing this theme a hypothesis is advanced to show that atomic bombing as a means of mass destruction will prove no more effective than did the conventional saturation bombing. Professor Blackett does much to allay the fears aroused by the threat of a conflict conducted by push-button scientists who might deluge the world with indescribable horrors by remote control. He furnishes a corrective for these fears by his sober analysis of the potentialities of the projected weapons.

The second theme developed in this thought-provoking book hinges upon the proposed peace-time uses of nuclear energy. Professor Blackett has little that is good to say for the Baruch or other plans advocated for the international control of the means of producing nuclear energy. He reasons further that the United States has such abundant sources of industrial power supply that she can very well forego the supplementary aid to be derived from nuclear energy. He contends that the development of atomic energy for power supply purposes should be turned over to such countries as Russia and the densely populated India, where power supplies are inadequate for present and future needs. If these countries were to be given the secrets of nuclear fission and permitted to proceed with its application (unrestrained by international supervision) they could, within a reasonable time, equate the high living standards of the American people and thus increase the welfare of mankind.

T. C.

BOOK NOTES.

ORGANIC SYNTHESIS, Vol. 28, edited by H. R. Snyder. 121 pp., 15 × 23 cm. New York, John Wiley & Sons, Inc., 1948. Price, $2.50.

This new volume of satisfactory methods for the preparation of organic chemicals continues a series which has long proved its worth. Thirty-seven syntheses are described, the data and method of presentation following that of previous years.

SEQUENCE IN LAYERED ROCKS, by Robert R. Schrock. 507 pp., illustrations, 15 × 23 cm. New York, McGraw-Hill Book Co., Inc., 1948. Price, $7.50.

In regions of intense folding and faulting, a determination of the top or bottom of beds becomes of great value in understanding the geological structure of the area. In this volume the author has presented a discussion of those features which aid in such top and bottom determination.

An introductory chapter is followed by one which considers the broad relationships such as superposition, faunal succession, unconformity, which are basic in determining geological events. The remainder of the volume treats exhaustively of the distinctive features of the various types of rock—sedimentary, igneous and metamorphosed.

The presentation is fully illustrated with photographs and drawings and is supported by a bibliography of more than 700 references. This should prove to be a distinctive contribution for those concerned with the top and bottom determination of geologic layers.

JAMES WATT AND THE INDUSTRIAL REVOLUTION, by H. W. Dickinson and H. P. Vowles. Second edition, 57 pp., illustrations, 16 × 22 cm. London, The British Council by Longmans, Green and Co., 1948. Price, $0.60 (paper).

This brochure, now offered in a second edition, presents a useful account of the life of James Watt whose development of the steam engine played such an important role in the Industrial Revolution. Historical perspective being necessary to an adequate understanding of this work, a summary is included of the earlier economic, scientific and technological developments leading up to the Industrial Revolution. With well chosen illustrations, it offers the busy reader a concise sketch of this outstanding figure.

ERRATUM: On page 79 of the January, 1949, issue, the publisher of "Natural Philosophy Through the Eighteenth Century and Allied Topics" was erroneously given as Edward Arnold & Co. The publishers are Taylor & Francis, Ltd., London.

CURRENT TOPICS.

Neutron Counter (*Instruments*, Vol. 22, No. 1).—A tiny atom-smashing device, no larger than a flower pot, has been developed by the Westinghouse Electric Corp. to detect and count neutrons, the vital building-blocks in the nuclei of atoms. The neutron counter was developed jointly by Dr. William E. Shoupp, manager of nuclear physics and electronics at the Westinghouse Research Laboratories and Dr. Kuan-Han Sun, Chinese-born research physicist.

Neutrons defy all ordinary methods of detection and study since they carry no electrical charge and cannot be detected directly by electrical means. The Westinghouse scientists took advantage of the atom-splitting qualities of the neutron to devise a method for trapping them. In the neutron counter, a small amount of uranium 235 is mixed with a special light-producing phosphor. The mixture is coated on the surface of an electron-multiplier photo tube. The whole device is contained within a metal cylinder which itself is lined with a 2" thick wall of paraffin to slow down fast moving neutrons. When a neutron passes through the paraffin shield and strikes the uranium-phosphor film on the tube, it splits the uranium atom or atoms. In the tiny explosion which takes place, nuclear fragments are hurled off and strike the phosphors, producing light rays. These light rays in turn produce electrons which then are multiplied a millionfold and collected at the end of the tube.

Thus neutrons recorded as flashing peaks of light on a fluorescent screen can be observed directly or the electrical impulses can be transmitted to electric circuits to give an accurate count of the atomic explosions taking place. The new detector can count the particles cast off by the exploding atoms at the rate of 100,000 a second—fifty times faster than the standard Geiger counter.

The detection of mesons—components of cosmic rays—may also be possible with the new instrument. "Although our work thus far has been confined to the recording of neutrons," Dr. Kuan said, "there apparently is no reason why the same instrument cannot be used to detect the heavy mesons recently discovered existing in the upper atmosphere and artificially made in the modern giant cyclotron."

Airborne Dark Room (*Science News Letter*, Vol. 55, No. 7).—Airborne photographic laboratories, equipped with a new processing machine capable of turning out 20,000 complete prints in a day, are promised for quick work in forward military areas. The complete, compact dark room would occupy the detachable fuselage of a Fairchild C-120, a version of the Flying Boxcar.

This type of plane has been compared with the modern truck-trailer from which the cargo carrier is quickly detached from the power unit. However, it is not a trailer. The cargo body is attached tightly in place snugly under the special plane itself, the built-in body of which is entirely for power and crew. The plane can land the cargo body wherever wanted, and then take off to pick up another body, or to travel to where needed without a cargo fuselage.

Only one of these so-called photo multi-processors, which uses assembly

line methods of producing prints, has as yet been built. It is at the Wright-Patterson Air Force Base, in Dayton, Ohio, and was built for the Air Force by Technical Service, Inc., Plymouth, Mich. When assembled for use, it is 31 ft. long, 17 in. wide, and approximately 5 ft. high. The device is made up of separate units which contain previewer, printer, developer, spray rinse, hypo bath, wash tanks and infra-red radiation air drier.

In printing, the processed aerial strip film is fed into one end of the machine. Movement of the negatives and dodging, which is achieved with the help of 24 lights, is operated manually. Paper advances automatically as the negatives are moved forward through the various chemicals and wash tanks. At the end of the multiprocessor, film or finished photographs come out again, the film ready for storage and the paper already cut into individual prints.

Electrical Thermometer for Remote and Multiple Indications.—A new electrical thermometer, designed particularly for the many industrial applications where remote indications are necessary, has been announced by the Weston Electrical Instrument Corporation.

Known as the Model 918, this thermometer employs a sensing element known as a resistor bulb, which is readily placed in tanks, grain bins, machines, etc., with the direct indicating instrument mounted any reasonable distance away from the bulb. With the incorporation of a selector switch and multiple bulbs, a number of temperature measurements are possible while using but one indicating instrument.

The Weston company said the Model 918 is already in use for continuous remote indicating of temperature of molds and baths, oil storage tanks, calender rolls in rubber plants, dough in bakery mixers, dam water for power plants, as well as waterwheel and turbine bearing temperatures. An airport obtains control tower indications of field temperatures 1500 feet distant, and a storage house containing 24 grain bins uses as many as 12 resistor bulbs per bin to maintain constant temperature checks.

Weston describes the Model 918 indicator as a ratio-type instrument with a scale over 5 in. long, having excellent control and damping, and showing quick response to temperature variations. It is designed for use on 100–130 volts, 50–60 cycles a-c, and is not affected by normal line voltage variation. It can also be supplied for use on d-c.

Radium-Beryllium Neutron Sources.—The United States Radium Corporation, New York, has announced the availability of new and improved radium beryllium neutron sources.

Investigations carried out over the past two years have resulted in the development of new preparation principles and techniques which have produced sources showing marked improvement in the neutron to gamma emission ratio, according to the company.

Quantitative measurements of neutron emission are not yet available, but comparative measurements with standard commercial sources indicate a major improvement in neutron output, the company said. New production techniques also have improved duplication of results, so that buyers can now obtain sources that do duplicate in neutron emission.

Sources can be provided in a powdered radium-beryllium mixture or a com-

pressed radium-beryllium mixture, in any size, from a few milligrams content for college laboratory routine experimentation, to 1000 or more milligrams for special applications. Packaged in stainless steel or magnetic iron capsules, all sources are made to order, and the design or shape of the container can be adjusted to meet special requirements.

Standard polonium-beryllium sources are also available, and special sources employing beta or gamma activated beryllium can be produced by arrangement with United States Radium Corporation.

New Ductile Cast Iron Available to Industry.—A new engineering material described as ductile cast iron, which combines the process advantages of gray cast iron, such as fluidity, castability and machinability, with the product advantages of cast steel, has been developed in the Research Laboratories of the Development and Research Division of the International Nickel Company, according to an announcement by the Company. Closing the gap between cast iron and cast steel, this material is characterized by a graphite structure in the form of spheroids, free from graphite in the flake form. Its excellent physical propertjes, particularly high elastic modulus, high yield strength and ductility, suggest its suitability for many applications hitherto considered beyond the scope of cast iron.

The production of this iron can be applied to common cast iron compositions melted in the cupola or in other kinds of furnaces, and is based on the introduction into the iron of a small but effective amount of magnesium or a magnesium-containing addition agent, such as nickel-magnesium alloy.

The announcement states that the new material will take its place along with malleable iron, gray iron and cast steel in providing the needs of industry. It will be advantageous to overall foundry practices as the new techniques should increase the importance of the foundry industry among metal producing industries.

The potential applications for this new material are obviously many and varied. The automotive, agricultural implement and railroad industries could apply it, both as cast and heat treated, in component parts too numerous to detail. Machinery in general including machine tools, crankshafts, pumps, compressors, valves and heavy industrial equipment, such as rolls and rolling mill housings, could readily utilize its high strength and rigidity. Its ductility may provide thermal shock resistance far greater than has been available in high carbon castings heretofore and suggests that superior performance might be obtained in items such as railroad car wheels and ingot molds. The superior resistance to growth and oxidation gives promise of its use in many engine, furnace and other parts used at elevated temperatures. Other products include pipe, textile machinery, electrical machinery, paper machinery and marine equipment. Service data will gradually accumulate to determine the improved quality, weight reduction and economy available in specific applications.

Lebanon Steel Foundary Builds $500,000 Plant for Secret Process Use.—Completion of a $500,000 plant addition, specially designed and equipped for the production of super-alloys under secret British processes recently acquired

by exclusive licensing agreement, was announced recently by William H. Worrilow, president of Lebanon Steel Foundry, Lebanon, Pa.

Doubling the Pennsylvania company's high-alloy steel casting facilities, the new plant and unique equipment installations are specially designed to enable the manufacture of high-temperature alloy castings under the patented techniques developed by Firth-Vickers Stainless Steels, Ltd., of Sheffield, England.

As exclusive American licensee, Mr. Worrilow said, Lebanon Steel Foundry already is utilizing the Firth-Vickers method in the production of super-alloy castings needed for warplane jet engines. Adaptations for other exacting military and industrial requirements also are under way.

Lebanon Steel Foundry is a leading supplier of stainless, special alloy and carbon steel castings for use in the oil, textile, mining, chemical, paper and pulp, and aviation industries, and for a variety of other exacting machinery and equipment requirements.

Radio Engineers Disclose Newest Navigation Aids, Television Improvements, Latest Tube Designs.—A new antenna with an unusual spinning, dipping motion which improves radar's detection of aircraft moving at very high velocities was described by Daniel Levine, Wright-Patterson Air Force Base, Dayton, Ohio, at the closing session of the 1949 National Convention of The Institute of Radio Engineers, held recently.

Mr. Levine's paper on "Principles of Volume Scan" received close attention because of the recent Congressional bill proposing a $161,000,000 radar "picket fence" around the United States. He presented equations of motion for an improved spiral scan on a radar system.

The new radar antenna described by Mr. Levine will have peculiar motions. As the elevation angle increases, the speed of rotation becomes more rapid until it spins at a tremendous rate when directed along the axis of rotation. The antenna then descends to its lowest level, suddenly, and the cycle is repeated.

"This unusual motion," said Levine, "provides a radar system with a uniform probability of detecting an aircraft in any portion of space and improves its coverage of aircraft that move at very high velocities."

Safer Plane Landing System.

Further refinements in the science of vertical aircraft navigation by automatically providing aircraft a precise reading of their altitude above the elevation of landing runways, were proposed and described in a paper by Ludlow B. Hallman, Jr., also of Wright-Patterson Air Force Base, Dayton, Ohio.

His paper on "The DIMEAL Approach and Landing System" proposes a special radar beacon installed at a point near the end of the runway and adjusted to indicate, on airborne instruments, the distance from the plane to the touchdown point in the runway. In addition, the beacon would also establish the course required for runway guidance.

Mr. Hallman proposed a pressure-type airborne altimeter having a rotating-shaft output as one of the basic elements for establishing a linear descent path from the aircraft from a designated point in the approach path to a point approximately 1000 feet from the point of touchdown and 50 feet above the runway elevation.

New Tube with "Visual Memory."

A new experimental tube which permits the storage of radar or television pictures in the form of electrical charges, was described by Louis Pensak of the RCA Laboratories Division, Princeton, N. J. In his paper on "The Graphechon—A Picture-Storage Tube," Mr. Pensak explained that the immediate application of this tube with a "visual memory" is for use with the Teleran System, one proposed by RCA for an all-weather airplane navigation system.

Under this system, the airborne pilot would receive a complete television picture containing a map of the ground, a radar plot of all nearby airplanes, his assigned pathway, weather and control tower information. The Graphechon tube is to provide the means of connecting the radar plot into a television picture. Its long-time storage is obtained by the use of a target coated with a very thin film of insulating material approximately half a micron thick. The tube is the first practical application of a hitherto unknown phenomenon that insulating materials can be made conducting by bombardment with electron beams and that their insulation recovers on removal of the bombardment.

Improvements in Television Relays.

A group of papers covering improvements in television relays were given. J. Z. Millar and W. B. Sullinger of Western Union Telegraph Company, New York presented a paper on "A Microwave System for Television Relaying," describing two television relay circuits between New York and Philadelphia. The relay circuits are independently reversible in short switching time, making possible the use of a single relay circuit for transmitting consecutive programs in opposite directions, thus reducing greatly the amount of equipment required.

The paper by William H. Forster, Philco Corporation, Philadelphia, on "Intercity Television Radio Relays," discussed specifications for television network facilities and compared them with design specifications and performance data of equipment used in the New York–Philadelphia circuit. Methods of improving the performance of the equipment were described.

The opening up of ultra-high-frequency bands, now so badly needed to extend television service, is a possible application of the Resnatron tube, discussed by W. W. Salisbury, Director of Research, Collins Radio Company, Cedar Rapids, Iowa. His paper on "Practical Applications of the Resnatron in the High-Power Transmitter Field" described new developments which make it possible to operate the tube as a high power amplifier. The tube was developed at Radio Research Laboratory at Harvard University, during the war, primarily for use as an oscillator.

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